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1996 WATER QUALITY ASSESSMENT
GUADALUPE RIVER BASIN
AND THE
LAVACA-GUADALUPE COASTAL BASIN

Prepared by:
Guadalupe-Blanco River Authority
and the
Upper Guadalupe River Authority

Prepared in Cooperation with
the Texas Natural Resource Conservation Commission
Under the Authorization of
the Clean Rivers Act

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TABLE OF CONTENTS

Section		Page
	SUMMARY	iv
I.	INTRODUCTION	1
	I.A BACKGROUND AND PURPOSE	1
	I.B STEERING COMMITTEE ROLE	4
	I.C ASSESSMENT APPROACH	5
	I.D PARTICIPATING AGENCIES	5
	I.E BASIN OVERVIEW	6
II.	PUBLIC PARTICIPATION AND EDUCATION	7
III.	REGIONAL ASSESSMENT AND TECHNICAL SUMMARY	9
	III.A BASIN PLANNING OVERVIEW	9
	III.B WATER QUALITY ASSESSMENT	12
IV.	RECOMMENDATIONS	24
V.	BASIN LONG TERM PLAN	26

APPENDIX A Steering Committee Members

APPENDIX B Public Involvement Materials

APPENDIX C Brush Control

APPENDIX D Regional Water Quality Assessment

LIST OF FIGURES

Figure		Page
I-1	Study Area Basins and Segments	2

LIST OF TABLES

Table		Page
III.B-1	Summary of Primary Screening Methods Provided by TNRCC	13
III.B-2	Step 4 Screening Results	19
III.B-3	Comparison of 1994 and 1996 Results	21

SUMMARY

The Texas Clean Rivers Act requires ongoing water quality assessments in each river basin in the state, with statewide summary reports generated by the Texas Natural Resource Conservation Commission (TNRCC) in even-numbered years. This report for the Guadalupe River Basin and the Lavaca-Guadalupe Coastal Basin covers two full years of work under the Clean Rivers Program (CRP). This report will be combined with other similar reports prepared by river authorities and other entities into a single statewide report to meet the requirements of the Clean Rivers Act.

The CRP encompasses a broad range of planning functions, with strong emphasis on public involvement and education. Work during the last biennium concentrated on four major areas:

Public involvement and education
Monitoring of water quality
Performing a number of studies, and
Assessment of existing water quality.

Public Involvement and Education

The Guadalupe-Blanco River Authority (GBRA) and the Upper Guadalupe River Authority (UGRA) are partners in the CRP and have maintained active and diverse public involvement efforts. Over the last two years, the GBRA and UGRA have made approximately two public presentations per month, and have produced numerous newsletters and press releases dealing with water quality issues. The Texas Watch Program has also been strongly supported.

In addition to these efforts, the CRP interacts with a Steering Committee that represents all parts of the basin. It is divided into four subcommittees, each covering a small number of counties to minimize travel time, and an overall executive Steering Committee. The committees provide local input to the CRP and are a forum for discussion of topics that might arise.

Monitoring Water Quality

Both authorities have extensive water quality monitoring programs that have been in operation for almost a decade, and both share this information with local media to help promote understanding by the public on water quality issues. During the last two years, both participated in a

review and analysis of the monitoring effort and identified an alternative program that promises to provide better information at roughly the same public cost.

Performing Special Studies

During FY-95 and 96, a number of special studies and projects were performed. These included:

- An assessment of the characteristics, existing population, and management needs of mussels in hydroelectric reservoirs,
- A request for citizen input or non-point water quality concerns,
- Continued work on the Hydrilla infestation problem in Lakes Dunlap and McQueeny,
- Producing an overview of Household Hazardous Waste Collection Programs,
- Summarizing material on water conservation programs,
- Producing two analyses of unclassified streams in the Kerrville area,
- Development of a program to be used by GBRA/UGRA to encourage brush control as a means to improve water conservation, and
- Development of a workplan to determine the stream flow requirements for aquatic habitat maintenance.

Assessment of Existing Water Quality

The assessment was prepared following CRP Guidance developed by the TNRCC. The major purpose of the Guidance was to assure that the water quality assessments were performed in a standardized method with results being produced in a uniform format. In this way the statewide report can be a consistent document. The basic thrust of the Guidance was to compile all existing water quality data in the basin into a single database and analyze these data using a standard set of analytical steps and criteria.

The water quality data available included the full range of conventional and special parameters, including toxic substances. Data were collected by four agencies: the TNRCC, the US Geological Survey (USGS), the GBRA and the UGRA. Data from the TNRCC and the USGS for 1982-1995 were provided by the TNRCC in a computer database format. Data from the GBRA and UGRA were converted to the same format and included in the standard database. Efforts are underway to standardize the data storage process for the GBRA and UGRA into a similar database so that it will be available for future analyses in a shorter timeframe.

Following the detailed Guidance procedures resulted in the identification of a number of points needing further analysis. In almost all cases it was found that there was a reasonable explanation for the observations. Overall, it was found that water quality in the Guadalupe River and Lavaca-Guadalupe Coastal Basins is excellent, with little cause for concern. This is partly due to several factors including the basin having a smaller population and associated wastewater discharges than other basins, an active and successful water quality management program, and to the substantial degree of flow regulation and water quality improvement provided by the Edwards Aquifer. While overall water quality is excellent, there are a number of measures that should be taken to insure continuation of this situation. These measures are included in the CRP workplan. Among them are:

1. Continued efforts at public education and involvement,
2. Continued work on undesirable plant growth in the smaller lakes east of IH-35,
3. Improvements in stream monitoring, and
4. Studies to better define flow needs for aquatic habitat preservation.

Through special studies of this type, combined with a coordinated basin planning and public involvement process, water quality in the basin can be maintained and improved.

I. INTRODUCTION

In 1991, the Texas Clean Rivers Act (also known as Senate Bill 818) became law. The act requires ongoing water quality assessments for each river basin in Texas, with comprehensive reports provided in even-numbered years. The Texas Natural Resource Conservation Commission (TNRCC) is to summarize each basin's report into a statewide assessment report to the Governor, Lieutenant Governor and Speaker of the House of Representatives on December 1 of even-numbered years.

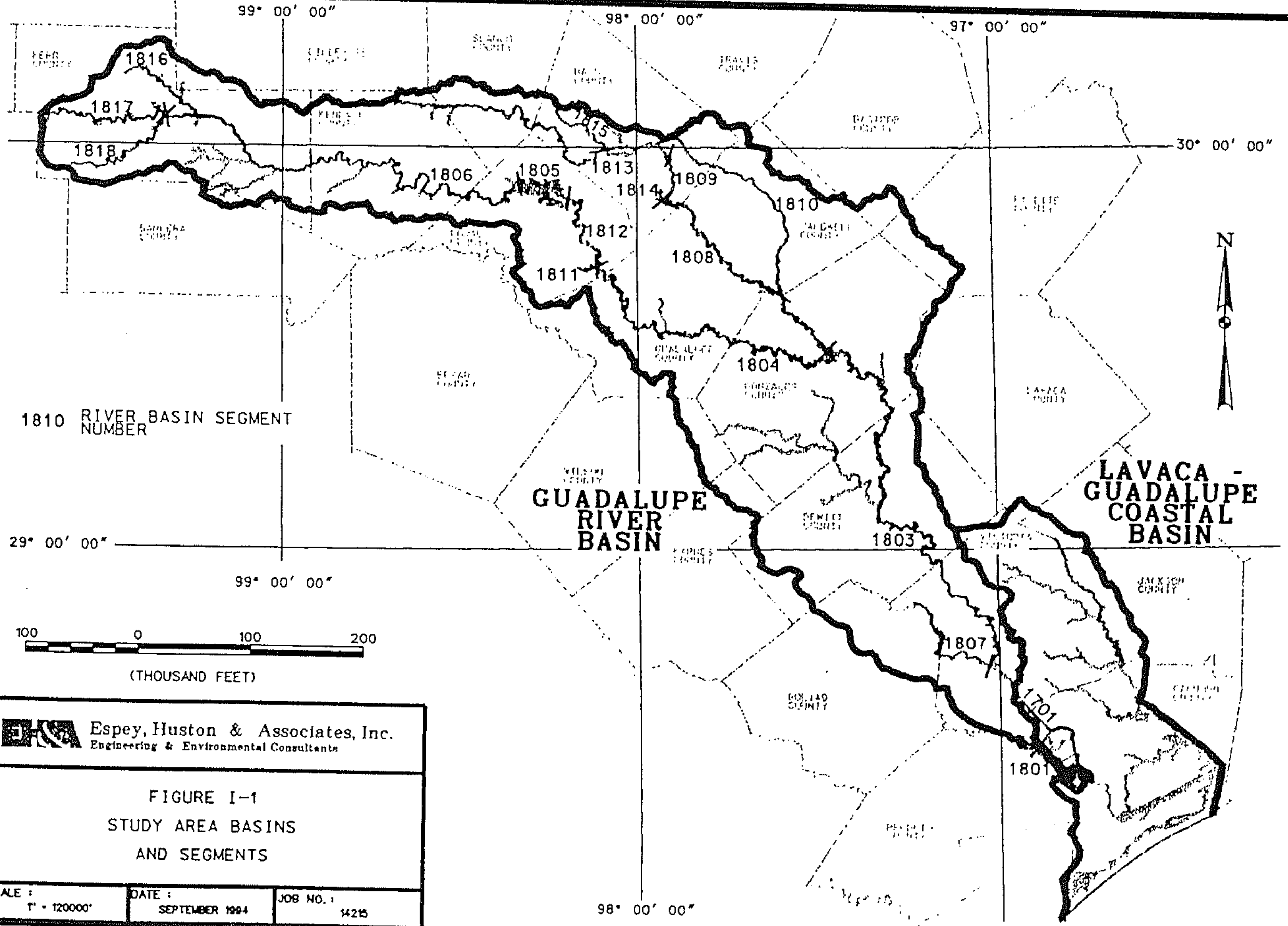
The legal basis for the assessment is provided in TITLE 31. NATURAL RESOURCES AND CONSERVATION; Chapter 320. Regional Assessments of Water Quality; §§320.1-320.9, Program for Assessment of Water Quality by Watershed and River Basin. The TNRCC staff along with the participating basin contractors (partners) are together referred to as the Clean Rivers Program (CRP). Funding for the overall effort is provided by fees on permitted municipal and industrial wastewater treatment systems and holders of water rights permits other than irrigation water rights.

The Guadalupe-Blanco River Authority (GBRA) in conjunction with the Upper Guadalupe River Authority (UGRA) have performed this regional water quality assessment under contract to the TNRCC. The assessment covers the Guadalupe River Basin and adjacent Lavaca-Guadalupe Coastal Basin. Figure I-1 shows the Guadalupe River Basin and the Lavaca-Guadalupe Coastal Basin, along with the designated water quality segments.

I.A BACKGROUND AND PURPOSE

This report presents a review of ongoing planning activities and an assessment of current water quality conditions in the basin. The assessment is a supporting step in a broader overall process of basin planning. The main planning objectives are to facilitate meeting the goal of maintaining and improving the quality of the state's water resources, and to provide for an improvement in the process of citizen involvement in achieving that goal.

The GBRA and the UGRA have a long history of water quality issues and management efforts. This has included both studies and actions to improve water quality. For example:



Espey, Huston & Associates, Inc.
Engineering & Environmental Consultants

FIGURE I-1
STUDY AREA BASINS
AND SEGMENTS

SCALE : 1" = 120000'	DATE : SEPTEMBER 1994	JOB NO. : 14215

Planning and Management

In 1968, both authorities initiated the Guadalupe Basin Water Quality Management Study, jointly supported by the GBRA, the Texas Water Quality Board, predecessor to the TNRCC, and the Federal Water Pollution Control Administration, the predecessor to the Environmental Protection Agency (EPA). The authorities also performed a number of water quality planning studies under the federal Section 208 program during the 1970's and early 1980's.

Both authorities maintain an active liaison with federal, state and local governments and are involved with water quality regulatory efforts including reviews of permit applications and inspections.

The UGRA works closely with TNRCC District 13 and frequently handles citizen complaints on water issues. It has also been involved with a number of separate studies of river water quality.

The UGRA has been a leader in water quality evaluations of a replacement for the fecal coliform (FC) test. These studies, undertaken at UGRA's expense, included parallel testing with the proposed E. coli test and analysis of differences.

Both authorities operate water quality laboratories which provide a wide range of services in their areas in addition to the primary role of supporting their monitoring programs.

Both authorities have also operated water quality monitoring programs in their basins for most of the last decade. They both also fund a portion of the US Geological Survey (USGS) monitoring program in their areas.

Water Quality Actions

Between 1948 and 1969, long before the term NON-POINT POLLUTION was coined, the GBRA was active in actually controlling excess sediment runoff from agriculture. At the urging of then Congressman Lyndon B. Johnson, the GBRA provided heavy equipment not available to farmers and ranchers, and constructed 6,994 miles of farm terraces, 443 miles of diversion ditches, 1,107 miles of field drains, and 3,934 controlled waterways. This program, now substantially adopted by the Natural Resource Conservation Service, made a substantial contribution to reduction of agricultural nonpoint sediment loads to streams, as well as reducing the loss of valuable topsoil.

The GBRA has issued over $75 million in pollution control and industrial development bonds in its 10-county area, and has built and operates a number of wastewater treatment facilities serving the area.

In 1981, using an EPA grant and local matching funds, GBRA dredged 100,000 cubic yards of decayed material from Lake McQueeney. Data were collected to document water quality improvements.

The UGRA has been a technological leader in the application of Aquifer Storage and Recovery (ASR) in Texas. It also operates one of the few flood control warning systems in the state.

The CRP has provided the opportunity to continue this work in several additional technical areas that would otherwise not have been possible. For example, the CRP has allowed the expansion of public education and involvement efforts and supported several special evaluations including monitoring, determining the precise locations of point sources and water diversion points, and evaluations of potential ground and surface water contamination from historical oil and gas activities. This report is an attempt to summarize the full scope of these basin planning activities.

I.B STEERING COMMITTEE ROLE

As part of the overall CRP planning process, a steering committee was established to provide representation over the entire basin. The function of the steering committee is advisory in nature. To minimize travel distances and time away from their occupations, the Steering Committee is divided into four subcommittees and an executive steering committee. The four subcommittees are:

the Coastal Basin Subcommittee,
the Lower Middle Basin Subcommittee,
the Upper Middle Basin Subcommittee, and
the Upper Basin Subcommittee.

The Executive Steering Committee consists of a representative from each of the counties for which water quality assessments are being performed. The representative for each county is elected by the persons of their respective counties serving on the subcommittee. In addition to a representative from each county, various state agencies have delegated a representative to serve on the Executive Committee. A list of the Steering Committee members is presented in Appendix A.

At the direction of the TNRCC, the GBRA prepares a draft workplan which outlines the work contemplated for the ensuing contract period. The draft workplan is presented to the Steering Committee for their review and comment, which is then incorporated into the draft workplan. The workplan is then submitted to the TNRCC and, depending on allocated funds and state priorities, the workplan is further modified.

The primary function of the Steering Committee is to provide a users perspective on water quality issues and priorities. Their input on water quality aspects and the role of the public in the process has been invaluable in the development of a quality program.

I.C ASSESSMENT APPROACH

The focus of this assessment report is on the overall process of basin planning. This includes public outreach and education programs, the inventories of wastewater dischargers and water rights permit holders, monitoring program evolution, and data management and analysis. This report also includes an assessment of existing water quality data, following procedures defined in TNRCC guidance. Essentially, this report is an overview of the CRP efforts during the last two years.

I.D PARTICIPATING AGENCIES

The assessment work was performed primarily by the GBRA and its contractor, Espey, Huston & Associates (EH&A) with assistance from the UGRA. The water quality data for most of the analyses were collected by the TNRCC and USGS along with the GBRA and UGRA. Other agencies such as the Railroad Commission of Texas (TRC), the Department of Agriculture, the Natural Resource Conservation Service, and the municipal and county governments of all parts of the basin, all provided essential information to produce the assessment.

In addition to the agencies participating directly in this assessment, the GBRA and UGRA work closely with other agencies on a wide range of water quality issues. For example, the GBRA is participating with the Texas Parks and Wildlife Department (TPWD), the Friends of Lake McQueeny, and the Lake Dunlap Property Owners Association in trying to control hydrilla, an exotic aquatic plant, in Lake Dunlap. One of the avenues being pursued is the U.S. Army Corps of Engineers' research on the "hydrilla fly", an insect that feeds only on hydrilla. Some other entities which have cooperated include the Commissioners Courts of Comal and Guadalupe counties, the Water Oriented Recreation District of Comal County, Chambers of Commerce, the Friends of the River Association, and the Texas River Protection Association.

I.E BASIN OVERVIEW

The Guadalupe River arises in Kerr County and flows 431.6 river miles in a southeasterly direction until it empties between Calhoun and Refugio Counties into San Antonio Bay. The Coastal Basin is the portions of Calhoun, Jackson, and Victoria counties which flow directly to the coastal waters.

The Guadalupe Basin covers an area of 6,070 square miles. The basin extends into a portion of 21 counties and has a population of approximately 302,000. The major cities, those with populations of more than 10,000, include: Kerrville, New Braunfels, San Marcos, Seguin, and Victoria. The City of Port Lavaca is the major city in the Coastal Basin. The principal economic activities in the basins are agriculture, recreation, mineral extraction, and petrochemical production.

The annual average discharge at the mouth of the Guadalupe River is 1,240,000 acre-feet. Major tributaries to the Guadalupe River are the Blanco, San Marcos, and Comal Rivers. Their respective length and annual average discharges are:

Blanco,	89.8 river miles and 110,100 acre-feet average discharge,
San Marcos,	74.2 river miles and 259,400 acre-feet average discharge,
Comal,	4.0 river miles and 219,800 acre-feet average discharge.

Average annual rainfall in the river basin is 33.02 inches, ranging from 29.75 inches for Kerr County in the hill country to 36.83 inches for Calhoun County on the coast. The principal tributaries to the Coastal Basin include Garcitas and Placedo Creeks.

The streams in the hill country portion of the basin are supplied largely by the Edwards Aquifer. Above Canyon Lake the Edwards Plateau Water Table Aquifer supplies the bulk of the flow while lower in the basin the artesian portion of the Edwards dominates. Between these two aquifers, the river tends to have very stable base flows and excellent quality waters.

II. PUBLIC PARTICIPATION AND EDUCATION

Public involvement is a means of building support for the Clean Rivers Program and developing a constituency to address identified water quality concerns. It is important that individuals residing within the river basin become aware of their potential impact, good or bad, on the quality of water in the basin's creeks, rivers, and lakes. The GBRA and UGRA continue to promote public consciousness regarding water quality issues and the status of water quality within the river basin through steering committees and other public forums, news releases, brochures, and the Texas Watch Program.

The steering committee is composed of representatives from state and local governmental agencies, political subdivisions, private industry, and individuals with an interest in and knowledge of river basin water quality conditions. While public attendance at generalized Clean Rivers Program meetings has been quite low, there has been good attendance at meetings by persons directly affected by a specific water quality problem when it has been addressed. The hydrilla infestation of the small hydroelectric lakes located between the cities of New Braunfels and Seguin is an example. Hydrilla is a non-native aquatic plant which grows rapidly and clogs lakes and rivers, interfering with water access and recreation. It is symptomatic of an abundance of nutrients. The GBRA has assisted in organizing lake management groups to address the proliferation of hydrilla and the underlying problem of nutrient enrichment.

A meeting of the Lavaca-Guadalupe Coastal Basin and the Guadalupe River Basin steering committee was held March 12, 1995, in Seguin, Texas. A progress report was made on the Texas Clean Rivers Program in the Lavaca-Guadalupe Coastal Basin and the Guadalupe River Basin and the stations and parameters of the forthcoming stream monitoring program were described. A presentation on *Water Quality Permitting through a Watershed Management Approach* was made by Jill C. Russell, Program Manager, Lavaca-Guadalupe Coastal Basin and the Guadalupe River Basin, Texas Natural Resource Conservation Commission; and Linda Brookins, Team Leader, Watershed Management Team, Texas Natural Resource Conservation Commission.

The Guadalupe-Blanco River Authority is a Texas Watch Program Partner in the Texas Natural Resource Conservation Commission's Texas Watch program. GBRA trains and supports volunteer groups in the Lavaca-Guadalupe Coastal Basin and the Guadalupe River Basin in the performance of various kinds of water quality monitoring activities. The *Clean Rivers* booklet and brochure were distributed to the Boerne Lions Club, at the Houston International Boat & RV Show, and to several student teachers for training material at their schools. Mailings of the TEXAS WATER

QUALITY, A SUMMARY OF RIVER BASIN ASSESSMENTS and the BASIN HIGHLIGHTS REPORT, GUADALUPE-RIVER BASIN AND THE LAVACA-GUADALUPE COASTAL BASIN have been made. Water quality data has been made available to the public, industry, and engineering consultants for use in planning, managing, and operating water treatment facilities and systems. GBRA and UGRA have promoted water conservation and river cleanups.

III. REGIONAL ASSESSMENT AND TECHNICAL SUMMARY

This section includes two broad divisions. One is an overview of the overall basin planning effort under the CRP Work Plan. It includes summaries of activities conducted over the last two years in major task areas. The second is a summary of the findings of the basin water quality assessment.

III.A BASIN PLANNING OVERVIEW

While much of the CRP effort is targeted to public education and a broad water quality assessment, a portion of the effort is reserved for smaller special studies designed to address particular issues. This section briefly reviews the efforts made during the 1995-96 biennium. The full reports of most of these efforts have been provided in other publications.

Mussels in Hydroelectric Reservoirs

Early in the CRP, the Steering Committee had noted that a commercial mussel fishery existed in some of the lower river hydroelectric reservoirs, and that there might be a concern with proper management of this fishery. Some delays occurred, but eventually a contract was developed with the Biology Department of Southwest Texas State University to study the fishery. A report was produced titled SURVEY AND CONDITION OF COMMERCIALLY HARVESTED MUSSELS IN H-4 (LAKE GONZALES) AND H-5 (LAKE WOOD) ON THE GUADALUPE RIVER, TEXAS. The principal investigators were T.L. Arsuffi and R.D. Perry. The report includes a literature characterization of the life cycle, habitat and food requirements, and reproduction rates of key species; interviews with people involved in the commercial fishery and Texas Parks and Wildlife personnel; field surveys of the current distribution and abundance of commercially important species; and a discussion of findings. The major finding was that the populations have been declining rapidly over the last ten years, due to a combination of heavy commercial harvesting in the 1992-94 period, and possibly the drought of 1988-89. There is much that is not known about the mussels and their possible recovery rates, but a moratorium on commercial harvesting was recommended.

Nonpoint Source Pollution Analysis

In the first years of the CRP, effort was focused on reviewing nonpoint source (NPS) concerns that had previously been identified by the TNRCC. In 1995 an attempt was made to have local citizens identify cases where a NPS was adversely affecting a use of surface water. The approach was to develop a news release describing NPS concerns and requesting the public's help in identifying such concerns. A news release was developed and distributed to newspapers throughout the basin. While it was used by a number of newspapers in the basin, only two responses were received.

Problems from Excessive Growth of Aquatic Vegetation

Over the last three years there has been a major bloom of Hydrilla in the small hydro lakes, primarily Dunlap and McQueeny. The density of the Hydrilla infestation is such that lake access, swimming and boating are severely restricted. The GBRA has been extensively involved in the analyses associated with this bloom and with ongoing work to control the Hydrilla infestation. The GBRA has worked closely with the TPWD on both herbicide uses and stocking the lakes with carp that could eat the Hydrilla. While a number of actions have been taken, at this writing the Hydrilla problem continues to be a major concern to lake users and lakefront residents.

Household Hazardous Waste Programs

In recent years, a number of municipalities and agencies have organized collection drives where local residents can dispose of unused chemicals which they may have in their residences. Such activities are perceived as popular and desirable environmental measures, and a CRP task was specifically designed to address such programs. An Overview of Household Hazardous Waste (HHW) Programs was produced which reviews existing programs, highlighting the potential benefits and drawbacks, and discusses at a general level the cost-effectiveness of each type of HHW program. It summarizes what is entailed in implementing a HHW program, but is not intended to be a detailed execution plan.

Goals and Objectives that Encourage Water Conservation

Water conservation continues to be a high priority of the CRP and GBRA-UGRA. This task reviewed the effectiveness of different conservation measures. To further these efforts, an Overview of Water Conservation Practices was produced. It documents the various programs that are employed in general and surveys specific programs employed in the Guadalupe River Basin. It also includes a review of conservation measures available to the water utility, produced by the Texas Water Development Board.

Analysis of Unclassified Streams

During FY-95, the UGRA was active in reviewing conditions in a number of tributary creeks to the Guadalupe River, using a range of testing methods. An analysis was performed on Turtle Creek, including both conventional chemical-bacterial analyses and Rapid BioAssessment work. The results indicated that this unclassified stream achieved aquatic life uses consistent with its presumptive "High" designation. The report also includes a substantial amount of additional chemical data at other stations. The basic data collection methods, using established TNRCC guidelines for habitat assessment, provides a good method of analysis of unclassified streams.

Analysis of Potential Septic Tank Effects on Quinlan Creek, Kerrville

The objective of this work was to determine and document the extent to which anthropogenic effects could be detected and the extent to which they restricted uses in Quinlan Creek. A report was produced documenting efforts made to identify sources and document concentrations. One heretofore unknown finding was that higher conductivities in the Creek were associated with an irrigation well operated by the Scott-Schreiner Golf Course. These higher conductivity waters could affect aquatic life and efforts are underway to find alternative irrigation water sources. Septic tank leachate was not found to be the cause of the higher conductivity readings.

Development of a Program to increase Water Conservation by Brush Control

Recent research has documented the harmful effects brush species, primarily Mountain Juniper but to a lesser extent Mesquite, have on water resources as well as land productivity and habitat value. During FY-96 a document was developed which reviewed existing brush control research and efforts, and recommends a program to encourage brush control efforts. This document, presented in Appendix C, has been reviewed by other agencies involved in brush control, and the GBRA plans to begin public information efforts on the program in the next few months.

Water Quality Monitoring Plan Development

A major effort of FY-96 was development of an expanded monitoring plan to supplement the already extensive monitoring efforts of the GBRA and UGRA. Among the features of the monitoring plan are the addition of 8 new stations in the GBRA area, a program of biological monitoring in both the GBRA and UGRA areas, and the collection of one set of trace metal data throughout the area.

Development of a Guadalupe River Instream Flow Needs Study Workplan

With the current drought, the issue of flow required for aquatic habitat maintenance and its effect on available water supplies, is of major concern throughout the Guadalupe River watershed. A workplan to address this major issue has been developed, and is currently awaiting TNRCC approval of the required contract modification. This would be a longer term undertaking that would extend past the current contract period, but starting work during this period is important to take advantage of the existing low river flows.

III.B WATER QUALITY ASSESSMENT

One of the requirements of the CRP is to assess available water quality data and, from this assessment identify water quality problems or concerns that should be addressed. This section summarizes the basin assessment, which is very similar to that performed in 1994. Details of data analysis are presented in Appendix D.

Development of the assessment required that all water quality data be compiled and integrated into a single database. In the 1994 assessment this was data from 1982-1992. In this assessment the data record was extended through 1995. Water quality data in the two basins (shown in Figure I-1) have been collected primarily by four agencies: the TNRCC, the USGS, the GBRA and the UGRA. Data from the TNRCC and the USGS for 1982-1995 were provided by the TNRCC in a computer database format. Data from the GBRA and UGRA were converted to the same format and included in the standard database. In the future, a goal will be to standardize the ongoing data storage process into a similar database so that it will be available for future analyses in a shorter timeframe.

With that database developed, the next step was a comparison of the data with a set of screening criteria developed by the TNRCC. This comparison process was highly structured with the TNRCC providing a guidance and a standard computer program to compare data, to insure uniformity in all parts of the state. The basic idea behind the standardized assessment is to identify potential water quality problems. To do this, the decision was made to compare all waters of the state in each basin to a standard set of screening criteria. The primary screening criteria are summarized in Table III.B-1, reproduced from the TNRCC Guidance document. The criteria cover most water quality parameters and are deliberately set in a conservative fashion on the theory that it would be better to identify a concern that did not really exist than to overlook a real concern.

TABLE III.B-1
SUMMARY OF PRIMARY SCREENING METHODS PROVIDED BY TNRCC

Parameter	Screening Criteria for: Classified Segments	Screening Criteria for: Unclassified Waterbodies	No. of Exceedences Which Require Proceeding to Secondary Screening	Measurements Evaluated
Temperature	TSWQS	No analysis	≥ 10%	Surface Measurements Only
pH	TSWQS	TSWQS of 1st downstream classified segment	≥ 10%	All Measurements
Conductivity/TDS	TSWQS for TDS x 0.75	TSWQS x 0.75 of 1st downstream classified segment unless downstream segment is saltwater; then, no analysis	≥ 10%	All Measurements
Cl and SO_4	TSWQS x 0.75	TSWQS x 0.75 of 1st downstream classified segment unless downstream segment is saltwater; then, no analysis	≥ 10%	All Measurements
DO	Spring mean criteria for aquatic life use designated in TSWQS	5.5 mg/L in fresh water and 5.0 mg/L in salt water unless aquatic life use has been determined; then, spring mean criteria for that aquatic life use	≥ 10%	For streams, surface measurements only; for reservoirs/lakes and ship channels, all measurements made from the epilimnion.
Fecal Coliform	TSWQS x 2	400 organisms/100 ml	≥ 10%	Surface Measurements Only

TABLE III.B-1 (Concluded)
SUMMARY OF PRIMARY SCREENING METHODS PROVIDED BY TNRCC

PARAMETER	SCREENING CRITERIA FOR: CLASSIFIED SEGMENTS		SCREENING CRITERIA FOR: UNCLASSIFIED WATERBODIES		NO. OF EXCEEDENCES WHICH REQUIRE PROCEEDING TO SECONDARY SCREENING	MEASUREMENTS EVALUATED
TEMPERATURE	TSWQS		No analysis		≥ 10%	Surface Measurements Only
NUTRIENTS: FRESH WATER	NO_3 - N NO_2 + NO_3 - N NH_3 - N Organic N Total N Total P	1.0 mg/L 1.0 mg/L 1.0 mg/L 2.0 mg/L 3.0 mg/L 0.2 mg/L	NO_3 - N NO_2 + NO_3 - N NH_3 - N Organic N Total N Total P	1.0 mg/L 1.0 mg/L 1.0 mg/L 2.0 mg/L 3.0 mg/L 0.2 mg/L	≥ 10% for any of the parameters	All Measurements
SALT WATER	NO_3 - N NH_3 - N Dissolved P o-PO_4-P Total P	0.4 mg/L ? 0.2 mg/L 0.2 mg/L 0.4 mg/L	NO_3 - N NH_3 - N Dissolved P o-PO_4-P Total P	0.4 mg/L ? 0.2 mg/L 0.2 mg/L 0.4 mg/L	≥ 10% for any of the parameters	All Measurements
METALS AND CYANIDE	Use 0.75 times most stringent value from Table 1 or Table 3 of TSWQS. If a hardness value is needed to calculate criteria, use value in Table 2 of TSWQS.		Use 0.75 times most stringent value from Table 1 or Table 3 of TSWQS. If a hardness value is needed to calculate criteria, use value in Table 2 of TSWQS.		≥ 1	All Measurements (total or dissolved)
ORGANICS	Detection limit		Detection limit		≥ 1	All Measurements

Source: Texas Clean Rivers Program FY94-95 Program Guidance

Data in each segment of the basin were compared with the screening criteria with four possible outcomes:

Insufficient Data (ID),
No detectable Concern (NC),
Possible Concern (PC), and
Concern (C).

As noted above, the screening criteria were set in a conservative fashion. While a conservative approach to any activity is generally desirable, the reader should be aware of some aspects discussed below.

The conventional parameters are defined in the existing Texas Surface Water Quality Standards (TSWQS) for each segment. The screening criteria were generally set as a fraction of the levels in the TSWQS, but do reflect differences between basins and segments to the extent that such differences are reflected in the standards. The reader should be aware that the values in the TSWQS for Total Dissolved Solids (TDS), Chlorides and Sulfates were developed from earlier analyses of segment water quality data. The values in the standards are not necessarily required to support a particular water use and are essentially empirical in nature. As water quality segments are frequently not homogeneous, data from a part of a segment that was not considered in the original standard setting analysis may exceed the value in the standards and/or the screening criteria. This does not necessarily constitute a water quality concern or problem.

Nutrient screening criteria are a single set of values to be applied across the state. At this time there are no water quality standards for nutrients, reflecting the different roles played by nutrients in different systems. Nutrients, primarily nitrogen and phosphorus, have the potential to limit aquatic plant growth if they are in low concentrations. This is the situation in many lakes and, a much more extreme example, the open ocean. Other minerals, notably silica and many trace metals also can be potentially limiting to plant growth in low concentrations. On the other hand, if there is an ample supply of nutrients, an excess level of plant growth can occur if that plant growth is not limited by some other factor such as light availability. In some cases a higher level of plant growth can be perceived as a water quality concern or problem, affecting aesthetic conditions, causing large daily dissolved oxygen fluctuations, and altering the aquatic community.

One difficulty with statewide screening criteria is that concentrations of major nutrients can be radically different in different systems, without there being significant differences in plant growth or water quality. For example, nutrient concentrations are typically over ten times higher than the screening criteria in effluent dominated streams, but because of turbidity or strong shade the stream may exhibit no excessive plant growth or other indication of quality problems. In other cases, nutrient concentrations much lower than the screening criteria could well be the cause of water quality concerns. Nutrient concentration alone is not sufficient to indicate anything definitive about the level of plant growth or water quality. Rather, the concentration must be considered in the context of a particular system. However, the level of complexity required for such a consideration is too great for a uniform statewide analysis. The screening criteria developed for this assessment are mid-range values that serve to focus attention on nutrients. However, an exceedance of these levels does not in itself constitute an actual water quality concern, nor does having lower concentrations than the criteria mean there is no concern.

There is also a screening criteria problem with trace metals which exist naturally and in most cases are essential micronutrients. The major problem with trace metals is not that they exist in very high concentrations but that they are very difficult to measure accurately[1] at near background concentrations. Essentially all of the existing metals data available for analysis were obtained using methods that the TNRCC and USGS now do not consider appropriate for quantification at low and sub part per billion concentrations. The historical data have been retained because they may have some use in identifying a major and persistent anomaly and because it is never appropriate to destroy data, but the data should not be considered reliable at low levels. Combining this difficulty with a set of standards that are in several cases close to background levels and it becomes very likely to have at least one value in the database for a segment which exceeds the screening criteria. While the existence of even one such detection in the database is termed a "concern" in this very conservative screening process, and certainly should be checked, the reader should recognize that data problems are the root cause of almost all screening criteria exceedances for metals.

[1]For example, the USGS Office of Water Quality, recognized the difficulty in a 1991 communication that was to be included in all data reports. In effect, the communication said that present USGS data above the microgram per liter level should be viewed with caution, and that actual levels without contamination problems may be substantially lower. The EPA has developed "clean" sampling and analytical methods which must be used for obtaining reliable ambient data.

BASIN WIDE SUMMARY

The analysis was first performed in the 1994 assessment. It is organized into six steps described below. For details of the analysis, see Appendix D.

1. **Preliminary Evaluation**--Essentially determining and documenting which data sets to include in the analysis.

2. **Primary Screening**--This included a number of necessary data conversions followed by an initial comparison of the data for each water quality segment with screening criteria listed in Table III.B-1. If more than a specified percentage of the data exceeded the screening criteria, it would be classed as a "possible concern" or "concern" depending on the percentage of values exceeding the criteria. If a water quality parameter for a particular segment were found not to exceed the specified criteria, no further analysis of that parameter for that segment would be needed.

3. **Secondary Evaluation**--This was a further review of the data to eliminate data errors and values that were clearly out of a reasonable range.

4. **Secondary Screening**--This was essentially a similar process to step 2, except that it employed slightly different criteria and was intended to only be employed on parameters that had been flagged as concerns in step 2.

5. **Analysis by Flow, Season and Time**--and

6. **Identify and Describe the Causes of the Water-Quality Concern**--These two steps were performed together as an evaluation of the concerns produced in the primary and secondary screenings.

The primary screening of the available data produced a large number of concerns and possible concerns, covering every segment in the basins and almost all water quality parameters. From the size of the list produced, it might be concluded that major water quality problems existed in the basin. However, this was not the ultimate result. Still, a large number of potential water quality concerns and possible concerns existed at the end of step 2 of the analysis.

Step 3, secondary evaluation, eliminated several obvious data problems, but had no effect on the concerns generated by the process. Most of the data were of excellent quality.

Step 4, the secondary screening, employed slightly different criteria. For example, in the analysis of chloride, sulfate and total dissolved solids concentrations, an annual average value (as specified in the Texas Surface Water Quality Standards) was employed rather than the more conservative percentage exceedance value used in Step 2. The use of the annual average method reduced the number of concerns with these parameters in Basin 18 substantially. Over all parameters, the list of concerns and potential concerns was reduced from 127 at the end of Step 2 to 67 at the end of Step 4. Table III.B-2 presents the results for both basins.

Steps 5 and 6 were the analysis of the 67 concerns generated from the standardized analysis system. In the 1994 Assessment, part of the Step 5/6 analysis was reviewing PCs and Cs by segment and part of the analysis was an analysis and discussion of parameters which exhibited PC-C findings. The basic conclusion of the 1994 segment and parameter analysis was that essentially all of the PC-C findings were attributable to screening criteria or data problems and not indicative of actual water quality problems.

As the data and screening procedures in this assessment are nearly identical to that used in the 1994 assessment, this analysis focuses only on the differences. Table III.B-3 presents a comparison of the Step 4 results in 1994 and 1996, organized by segment. The results are very similar, with no differences in temperature, pH and DO, and the elimination of PC-C results for FC. These parameters can be dropped from segment discussion as they are all NC (no concern) reports. However, a few individual stations that were not associated with segments will be discussed in relation to these parameters.

One of the stations was 12540, Carper's Creek, a tributary to the Blanco River, segment 1813. This TNRCC station has two brief periods of intensive monitoring, one of which was in September, 1988. During what appears to be a diurnal sampling many of the DO observations were less than 6 mg/L (the lowest was 4.7 mg/L), resulting in a C on Table III.B-2. This does not appear to be a serious concern. The next stations were 12563, 64 and 65, which are on Third Creek in Kerrville and which are dominated by the Kerrville WWTP effluent. In addition to the usual nutrient parameters, 8 out of 47 DO observations were lower than 6 mg/L. The third station was 12568, Fifteen Mile Creek on at US 183. In addition to nutrients, this station had 4 of 15 observations above the temperature

TABLE III.B-2
SUMMARY OF STEP 4 DATA ANALYSIS RESULTS WITH C AND PC

Seg. id	Storet Code	Description of Parameters	No. of Data	No. Screened	Mean	15th%	Median	85th%	Std Dev	Max	Min	IQR	Criteria	Exceed Human Health	No. Exceeding Criteria	Percent Exceeding Criteria	MAL	No. Exceeding MAL	Percent Exceeding MAL	Conclusions
Basin 17																				
1701	00610	NITROGEN, AMMONIA, TOTAL (MG/L AS N)	46	46	0.381	0.025	0.085	0.38	1.464	10.11	0.005	0.182	0.15		16	34.8	0	16	34.8	PC
	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	44	44	0.175	0.015	0.102	0.398	0.178	0.72	0.005	0.296	0.4	N	6	13.6	0	6	13.6	PC
Basin 18																				
1801	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	102	102	1.662	0.995	1.6	2.295	0.788	4.2	0.005	0.712	0.4	N	97	95.1	0	97	95.1	C
	00630	NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	75	75	1.559	1.064	1.59	2	0.552	3.21	0.015	0.572	0.4		73	97.3		73	97.3	C
	00665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	103	103	0.747	0.43	0.6	0.912	0.797	8.22	0.28	0.298	0.4		94	91.3		94	91.3	C
	00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P)	101	101	0.584	0.276	0.47	0.757	0.781	7.93	0.005	0.339	0.2		99	98.0		99	98.0	C
	01042	COPPER, TOTAL (UG/L AS CU)	11	9	9.967	1.67	7.8	21	7.62	21	0.5	15.22	18.167		2	22.2	10	2	22.2	PC
	01051	LEAD, TOTAL (UG/L AS PB)	11	3	6.3	2.488	2.5	14	5.445	14	2.4	9.28	5.3631	Y	1	33.3	10	1	33.3	PC
	01092	ZINC, TOTAL (UG/L AS ZN)	10	10	47.3	10	26	78.86	46.16	170	10	48.7	150.04		1	10.0	5	1	10.0	PC
	71900	MERCURY, TOTAL (UG/L AS HG)	11	11	0.673	0.1	0.5	1.328	0.935	3.4	0.1	0.4	1.1	Y	2	18.2	2	1	9.1	PC
1803	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	263	263	1.701	0.559	1.2	2.6	1.823	16.9	0.015	1.345	1	N	162	61.6	0	162	61.6	C
	00625	NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)	126	126	0.743	0.3	0.7	1.1	0.424	2.2	0.1	0.6	1		28	22.2		28	22.2	PC
	00630	NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	77	77	1.973	0.998	1.8	3.202	1.058	5.1	0.3	1.2	1		63	81.8		63	81.8	C
	00665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	380	380	0.496	0.1	0.35	0.936	0.526	4.32	0.02	0.54	0.2		246	64.7		246	64.7	C
	00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P)	148	148	0.137	0.04	0.1025	0.271	0.112	0.49	0.005	0.161	0.2		38	25.7		38	25.7	PC
	01025	CADMIUM, DISSOLVED (UG/L AS CD)	63	62	0.661	0.5	0.5	1	0.429	3	0.5	0	2.165	N	1	1.6	1	1	1.6	PC
	01049	LEAD, DISSOLVED (UG/L AS PB)	63	53	2.132	0.5	2	3.62	2.024	10	0.5	2	9.0742	N	1	1.9	10	0	0.0	PC
	01051	LEAD, TOTAL (UG/L AS PB)	4	4	16.75	8.12	13	32.43	9.627	33	8	14.65	9.0742	Y	3	75.0	10	3	75.0	C
	01075	SILVER, DISSOLVED (UG/L AS AG)	75	3	1	1	1	1	0	1	1	0	0.49	N	3	100.0	2	0	0.0	PC
	39516	PCBS IN WHOLE WATER SAMPLE (UG/L)	11	1	0.1	0.042	0.1	0.058	0	0.1	0.1	0.04	0.014	Y	1	100.0	0.65	0	0.0	PC
	71890	MERCURY DISSOLVED, IN WATER (UG/L)	63	63	0.095	0.05	0.05	0.1	0.174	1.4	0.05	0.05	1.3	Y	1	1.6	2	0	0.0	PC
1804	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	166	166	1.118	0.595	1	1.497	0.739	6	0.01	0.571	1	N	82	49.4	0	82	49.4	PC
	00625	NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)	64	64	0.661	0.3	0.5	1.097	0.495	2.9	0.1	0.428	1		10	15.6		10	15.6	PC
	00630	NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	65	65	0.857	0.6	0.876	1.2	0.314	1.5	0.05	0.409	1		17	26.2		17	26.2	PC
	01027	CADMIUM, TOTAL (UG/L AS CD)	20	2	3.2	4.028	3.2	5	1.8	5	1.4	-0.07	1.9547	N	1	50.0	1	1	50.0	PC
	01042	COPPER, TOTAL (UG/L AS CU)	20	20	60.43	6.865	10	10	224.7	1040	1	0	23.137		1	5.0	10	1	5.0	PC
	71900	MERCURY, TOTAL (UG/L AS HG)	20	20	0.342	0.1	0.17	0.314	0.753	3.6	0.1	0.1	1.3	Y	1	5.0	2	1	5.0	PC
1806	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	2,939	2,939	0.907	0.3	0.6	1.3	1.419	18.3	0	0.6	1	N	672	22.9	0	672	22.9	PC
	00630	NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	25	25	0.597	0.304	0.43	1.064	0.371	1.5	0.1	0.521	1		4	16.0		4	16.0	PC
	01075	SILVER, DISSOLVED (UG/L AS AG)	20	2	1	1.46	1	2	1	2	0	-0	0.49	N	1	50.0	2	0	0.0	PC

TABLE III.B-2 (Concluded)
SUMMARY OF STEP 4 DATA ANALYSIS RESULTS WITH C AND PC

Seg. id	Storet Code	Description of Parameters	No. of Data	No. Screened	Mean	15th%	Median	85th%	Std Dev	Max	Min	IQR	Criteria	Exceed Human Health	No. Exceeding Criteria	Percent Exceeding Criteria	MAL	No. Exceeding MAL	Percent Exceeding MAL	Conclusions
1808	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	161	161	1.236	0.732	1.1	1.538	0.883	8.51	0.18	0.502	1	N	94	58.4	0	94	58.4	C
	00625	NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)	9	9	0.548	0.263	0.34	0.954	0.331	1.18	0.13	0.527	1		1	11.1		1	11.1	PC
	00665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	163	163	0.157	0.069	0.12	0.24	0.156	1.38	0.005	0.11	0.2		34	20.9		34	20.9	PC
	00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P)	52	52	0.117	0.034	0.095	0.188	0.098	0.62	0.005	0.09	0.2		6	11.5		6	11.5	PC
1810	00300	OXYGEN, DISSOLVED (MG/L)	110	110	6.135	4.8	5.85	7.307	1.64	13	1.2	1.6	5		25	22.7	0	25	22.7	PC
	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	52	52	2.683	0.518	2.15	5.537	2.225	7.99	0.08	3.405	1	N	35	67.3	0	35	67.3	C
	00625	NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)	21	21	0.78	0.6	0.7	1.101	0.282	1.6	0.27	0.2	1		4	19.0		4	19.0	PC
	00665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	54	54	0.803	0.346	0.565	1.434	0.531	2.14	0.17	0.844	0.2		53	98.1		53	98.1	C
	00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P)	54	54	0.647	0.234	0.48	1.324	0.504	2.13	0.005	0.6	0.2		48	88.9		48	88.9	C
1811	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	58	58	1.625	1.383	1.645	1.8	0.353	2.7	0.224	0.261	1	N	56	96.6	0	56	96.6	C
1812	01049	LEAD, DISSOLVED (UG/L AS PB)	18	5	4.7	0.59	2	10	4.354	10	0.5	9.15	7.2027	N	2	40.0	10	0	0.0	PC
	01075	SILVER, DISSOLVED (UG/L AS AG)	18	1	1	0.42	1	0.58	0	1	1	0.4	0.49	N	1	100.0	2	0	0.0	PC
1813	01025	CADMIUM, DISSOLVED (UG/L AS CD)	14	14	0.714	0.5	0.5	1.205	0.525	2	0.5	0	1.5595	N	2	14.3	1	2	14.3	PC
	01049	LEAD, DISSOLVED (UG/L AS PB)	14	7	4.714	1.46	2.5	11.6	6.278	20	0.5	0	5.331	N	1	14.3	10	1	14.3	PC
	01075	SILVER, DISSOLVED (UG/L AS AG)	14	2	1	1	1	1	0	1	1	-0.05	0.49	N	2	100.0	2	0	0.0	PC
1814	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	23	23	1.221	1.034	1.17	1.335	0.301	2.46	0.78	0.178	1	N	20	87.0	0	20	87.0	C
1816	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	184	184	2.221	0.4	0.9	1.9	14.58	199	0.07	0.882	1	N	73	39.7	0	73	39.7	PC
1817	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	136	136	1.479	0.4	0.82	1.968	2.496	23	0.1	0.9	1	N	57	41.9	0	57	41.9	PC
1818	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	185	185	1.113	0.3	0.5	1	3.424	33	0.03	0.4	1	N	26	14.1	0	26	14.1	PC
12540[1]	00300	OXYGEN, DISSOLVED (MG/L)	48	48	7.142	5.278	6.805	9.335	1.703	10.81	4.74	2.428	6		15	31.3	0	15	31.3	C
12563[2]	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	66	66	4.552	0.733	1.9	12.7	4.837	14.6	0.13	5.6	1	N	47	71.2	0	47	71.2	C
	00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P)	15	15	0.059	0.013	0.023	0.139	0.09	0.294	0.012	0.018	0.2		2	13.3		2	13.3	PC
12564[3]	00300	OXYGEN, DISSOLVED (MG/L)	47	47	7.892	5.648	7.7	9.9	2.095	12.8	3	3.052	6		8	17.0	0	8	17.0	PC
	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	49	49	12.72	6.114	14.2	17.94	5.155	19.7	0.05	7.8	1	Y	48	98.0	0	48	98.0	C
12565[4]	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	60	60	4.729	1.3	2.2	7.657	7.029	30.7	0.6	2.229	1	N	54	90.0	0	54	90.0	C
12568[5]	00010	TEMPERATURE, WATER (DEGREES CENTIGRADE)	15	15	26.97	16	28.3	34.03	6.923	36	13.5	11.02	33.889		4	26.7		4	26.7	C
	00665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	11	11	0.201	0.071	0.19	0.354	0.151	0.55	0.01	0.196	0.2		5	45.5		5	45.5	PC
	00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P)	11	11	0.109	0.01	0.15	0.208	0.081	0.22	0.005	0.162	0.2		2	18.2		2	18.2	PC

[1] CARPERS CREEK ON KNOX RANCH 4 MILES SOUTHEAST OF FISCHER
[2] THIRD CREEK, 0.2 KM ABOVE CONFLUENCE WITH GUADALUPE RIVER
[3] THIRD CREEK, 0.5 KM ABOVE CONFLUENCE WITH GUADALUPE RIVER
[4] THIRD CREEK AT SPUR 100 IN KERRVILLE
[5] FIFTEENMILE CREEK AT US 183 SOUTH OF CUERO

TABLE III.B-3
COMPARISON OF 1994 AND 1996 ASSESSMENT RESULTS

Segment		Temp.		pH		TDS		CL		SO4		DO		FC		Nutrients		Metals		Organics	
		1994	1996	1994	1996	1994	1996	1994	1996	1994	1996	1994	1996	1994	1996	1994	1996	1994	1996	1994	1996
1701	Victoria Barge Canal	NC	NC	NC	NC	NA	NA	NA	NA	NA	NA	NC	NC	C	NC	PC	PC	ID	NC	ID	ID
1801	Guadalupe River Tidal	NC	NC	NC	NC	NA	NA	NA	NA	NA	NA	NC	NC	PC	NC	C	C	C	PC	ID	ID
1803	Guadalupe River Below San Marcos River	NC	NC	NC	NC	C	NC	C	NC	NC	NC	NC	NC	C	NC	C	C	C	C	ID	PC
1804	Guadalupe River Below Comal River	NC	NC	NC	NC	PC	NC	NC	NC	NC	NC	NC	NC	NC	NC	C	PC	ID	PC	ID	ID
1805	Canyon Lake	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	ID	ID	ID	ID
1806	Guadalupe River Above Canyon Lake	NC	NC	NC	NC	NC	NC	PC	NC	NC	NC	NC	NC	NC	NC	PC	PC	NC	PC	ID	ID
1807	Coleto Creek	NC	NC	NC	NC	C	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	ID	ID	ID	ID
1808	Lower San Marcos River	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	C	C	ID	ID	ID	ID
1809	Lower Blanco River	NC	NC	NC	NC	NC	ID	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	ID	ID	ID
1810	Plum Creek	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	PC	PC	NC	NC	C	C	ID	ID	ID	ID
1811	Comal River	NC	NC	NC	NC	NC	NC	NC	NC	PC	NC	NC	NC	NC	NC	C	C	ID	ID	ID	ID
1812	Guadalupe River Below Canyon Dam	NC	NC	NC	NC	NC	NC	NC	NC	NC	PC	NC	NC	NC	NC	NC	NC	ID	PC	ID	ID
1813	Upper Blanco River	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	PC	PC	ID	ID
1814	Upper San Marcos River	NC	NC	NC	NC	ID	NC	ID	ID	NC	NC	NC	NC	NC	NC	C	C	ID	ID	ID	ID
1815	Cypress Creek	NC	NC	NC	NC	NC	NC	NC	ID	NC	ID	NC	NC	NC	NC	NC	NC	ID	ID	ID	ID
1816	Johnson Creek	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	PC	PC	ID	ID	ID	ID
1817	North Fork Guadalupe River	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	PC	PC	ID	ID	ID	ID
1818	South Fork Guadalupe River	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	PC	PC	ID	ID	ID	ID

Note: "Conclusion of Water Quality Assessment for" spans the Temp. through Organics columns.

Note:
ID = Insufficient data.
NC = No detectable concern.
PC = Possible concern.
C = Concern.
NA = Marine waters, criteria do not apply.

screening level of 93 ° F (33.889 °C), with the highest being 96.8 °F and the mean 80.5 °F. This does not appear to be a thermal pollution concern.

There are some differences with the 1994 assessment in the dissolved solids parameters--TDS, CL and SO4. Part of the difference stems from there being a small amount of additional data and part comes from the Paradox script being hardwired to only employ data beginning in 1990, rather than the 1982 beginning point in the previous assessment. One change is that segment 1803 no longer shows the C that was associated with the San Antonio River values, probably reflecting a somewhat wetter period of record. Similar changes were found for segment 1804 for TDS, 1806 for CL, and 1811 for SO4. Segment 1812 switched from NC to PC for SO4. In this case one year's average exceeded the criterion which, because there was only six years of record, triggered the PC. Some segments changed from NC to ID, probably reflecting the shorter period of record. Segment 1807 (Coleto Creek) changed from C to NC for a different reason; a USGS station which had caused the C result was moved by the TNRCC to a separate station. Overall, the results were as before with no actual water quality concerns associated with dissolved solids for the segments.

As noted in Table D4-2, two stations exceeded the ambient dissolved solids criteria in a convincing manner. One was 12564, which is effluent from the City of Kerrville and should not be compared to ambient criteria, and the other is 13657, Sandies Creek. As noted in the 1994 Assessment, the Sandies Creek station is in a different watershed from the main stem of the river, where the comparison criteria were drawn. Neither station result indicates an actual water quality concern.

The next parameter to be addressed is nutrients. Here the two assessments are nearly identical. The only difference is that segment 1804 switched from a C to a PC. This appears to be because of the small addition of data points (increase from 152 to 166) caused the percent exceeding the 1 mg/L screening level to drop from 51.3% to 49.4%. Clearly this difference is not significant. The basic conclusion of the 1994 Assessment, that nutrient C-PC results are a function of the screening criteria selected, still holds.

The metals results show a substantial number of differences between the two assessments. Some of the reasons for the differences are: the addition of new data, the use of somewhat different hardness values in the calculation of the freshwater criteria, and the method of determining whether the Insufficient Data tag should be applied. However, these differences are relatively minor in comparison to the basic point discussed in the 1994 Assessment that the data were obtained with methods that are not considered reliable for quantification at the levels employed for screening. Referring back to Table D4-3 which includes the details of the metal screenings, it can be seen that the dissolved values are quite low, with a small percentage exceeding the screening levels (which is still sufficient to produce a PC). The only C result came from older total lead data (4 samples). The differences with the '94 Assessment involving IDs are a result of different interpretations of the Guidance on how a screening exceedance, even if there are not enough samples to meet the criteria, should be counted. Overall, the metals results are the same as in the 1994 Assessment, with no indication of a trace metal water quality problem.

The final parameter is the organics. As in the 1994 Assessment, there is very little organic data. This is to be expected as there are very few potential sources of industrial organic compounds and thus little need for extensive monitoring of these substances. The database does include a substantial amount of pesticide data collected over the years. These data did not exceed screening levels. The only organic value to trigger a PC was one sample out of 11 measurements of PCBs in water in segment 1803. The basic conclusion is the same as in 1994--there is not a water quality concern with organic chemicals in the basin.

In summary, as in 1994 this review of existing water quality data indicates there are no significant water quality concerns in either basin. There are a number of reasons for this result including a lack of major population centers and heavy industry, an active and successful water quality management program, and a substantial degree of flow regulation and filtration provided by the Edwards Aquifer.

IV. RECOMMENDATIONS

Based on the results of the regional water quality assessment and a review of the overall effort, several recommendations are provided:

A. The water quality assessment was performed using TNRCC-developed Program Guidance. The Guidance specified a single set of screening criteria, some of which are based on segment water quality standards, for use in all basins of the state. In any future assessments, it is recommended that analyses be tailored to the specific conditions and uses of segments or even portions of segments as appropriate.

B. A related point is the desirability of developing additional water quality criteria that are appropriate to the characteristics of particular segments. Presently, segment-specific criteria are mandated for only seven parameters (DO, pH, FC bacteria, Temperature, Chloride, Sulfate and TDS). In some segments it may be desirable to consider additional parameters such as nutrients in the standards.

C. The CRP is meeting its mandated goals of increasing public involvement and education. These aspects of the program appear to be functioning well.

D. One of the major longer-term goals of the program is to increase access to water quality data. To accomplish this, the CRP's program to standardize data storage in a unified database (Paradox) should be continued. At this point, data from all four agencies have been transferred to the database.

E. To improve the overall program performance and reduce costs, ways to streamline the contracting process need to be developed.

F. There are several tentative conclusions which can be reached from the assessment along with other studies in the basin.

- The first is that an analysis of existing water quality data indicates there are no significant water quality concerns in the basin. This is to be expected because the basin has relatively little human development and excellent natural conditions. The finding is consistent with the previous assessments.

- While there are no water quality concerns, there is a continuing concern with the Hydrilla infestation on Lakes Dunlap and McQueeny. The CRP should continue to work the Texas Parks and Wildlife Department and interested citizen groups on this problem.

- A water quality management issue that continues to be important to both authorities, local interests, and the CRP is assuring that waters used heavily for contact recreation are safe for swimming and free of unsightly litter. The CRP should continue to support these efforts.

- A technical area that is becoming a major concern is water availability, in particular aquatic habitat protection flow requirements. A program to address this issue has been developed by the CRP.

V. BASIN LONG TERM PLAN

This section is divided into nine subsections corresponding to the nine goals established by the TNRCC for the CRP Long Term Plan.

1. Enhance Public Participation and Education

The population of the basin should have confidence that its water resources are being protected and enhanced in a reasonable and cost-effective manner. Before that confidence can exist, there must be a strong and effective communication process. The GBRA and UGRA are committed to a strong public education and involvement program throughout the basin. This includes hosting a wide range of public meetings and educational opportunities, and promoting volunteer environmental monitoring. Perhaps as important in this process is a commitment to listen to public concerns.

A measure of the program's commitment to this goal is that over the program's life, roughly one fourth of the total budget has been invested in this area. The program intends to keep this proportion of funding into the future. In addition, it intends to promote citizen participation in the resolution of water quality issues.

2. Encourage Comprehensive Watershed Planning

Comprehensive watershed planning brings a measure of cohesion to the decisionmaking process, by forcing a wide range of interests to interact in an integrated manner. The CRP is committed to this planning process. The program's commitment is exemplified by having a Steering Committee composed of all major interest groups and agencies, with the mission to work together to solve the basin's problems. In addition, plans are well underway to integrate the existing monitoring efforts into a basin-wide water quality database.

3. Identify Pollutant Sources

A "pollutant" can be defined as something introduced in excess quantity which damages or restricts a use which existed before the pollutant was introduced. A classic example would be organic material in raw sewage discharged to a stream which would oxidize rapidly producing a reduction in the dissolved oxygen concentration of the stream, which killed the fish which were previously caught by the same people who started discharging the sewage. In this case, it is clear that a use existed that was damaged, that high Biochemical Oxygen Demand (BOD) can be identified as the major pollutant, and that the pollutant source is the sewage discharge.

Today, with all wastewater sources treated and regulated carefully, the situation is much more complex. The very low concentration of BOD in treated wastewater may not be a pollutant because it has little or no effect on the stream oxygen level. Pollution may still exist but it is more complex and harder to identify.

An example might be the flow and total suspended solids (TSS) in runoff from a small watershed. After urban development in the watershed, the peak rate of runoff flow and TSS concentration during a given rain may have doubled. The result might be erosion in some place and the filling in of low spots in the streambed, which had been a haven for fish during dry periods. The increment in peak flow TSS concentration can thus be considered as a pollutant, with the source being urban development. However, the original flow/TSS input was not a pollutant but an essential part of the stream system.

From this discussion, it is clear that identification of pollutants and sources is not always obvious. In some cases, it may require a substantial amount of study. The CRP provides the mechanism for proper identification of pollutants. A key element of the process is the use of modern scientific methods. The GBRA and UGRA are committed to these studies and the process of proper pollutant source determination.

4. Provide a Scientific Approach to Problem Areas

As discussed in the previous goal of pollutant source identification, a scientific approach is essential to producing technically valid analyses of complex water quality issues. The basics of the scientific method include: becoming familiar with previous work and available data; formulation of hypotheses to explain observed processes; testing of hypotheses with new or existing data; and publication of the results for proper peer review. Some of the tools of this scientific approach include trend analyses, the usual range of statistical tests, and quantitative numerical simulation (numerical models) to understand processes and test hypotheses.

The CRP provides the mechanism and commitment to allow a comprehensive analysis and assessment of complex issues. The GBRA and UGRA are committed to following proper scientific methods in identifying problems and evaluating solutions.

5. **Focus on Priority Issues**

As in all aspects of life, priorities must be established. Scientific studies and input from diverse public interests are essential in the formulation of sound priorities. The CRP, having all of these components, is a logical vehicle for determining priorities and establishing the emphasis on those issues where there is the greatest potential benefit to the public.

One limitation that must be accepted at this point is that while the CRP has the basinwide membership to allow formulation of a meaningful consensus on issues, it can only serve in an advisory capacity. The real agenda-setting power is through regulatory authority residing in the TNRCC.

6. **Prevent and Reduce Pollution at the Source**

This goal would seem to be fundamental in that it would theoretically be the most cost-effective approach. However, as with most aspects of a complex world, the existence of exceptions must be acknowledged. A case in point is the definition of "source". For example, conventional wisdom holds that all pollution problems have their source in man's activities in the basin. A reduction of population in the basin would reduce pollution at the source but would generally not be viewed as a socially desirable solution. Accordingly, the real goal of the CRP is to find the best overall compromise between man and the environment.

7. **Ensure Better Use of Public Funds**

The CRP will make a concerted effort to see that limited public funds are used in an efficient manner. A key component of this effort is the basin approach, where agencies and interests working within the watershed can minimize duplication of efforts through coordinated work. Another key element of the CRP endorsed by GBRA and UGRA is the use of volunteer efforts to minimize costs.

8. **Promote Water Conservation**

Water conservation is desirable from many perspectives, including reducing the likelihood of shortages and reducing the cost of developing new supplies. The CRP and GBRA/UGRA are both committed to responsible water conservation efforts through public education and pricing mechanisms designed to promote conservation.

9. Provide Assistance for Local Initiatives

The GBRA and UGRA have long functioned as central repositories of water quality information and supported a wide range of local programs. Both have operated water quality laboratories for many years which support the public in a wide range of areas from testing well water to performing special studies. The CRP is a logical extension of these efforts. In particular, the public education and involvement programs funded through the CRP should continue to increase the utility of these efforts. As point source problems are solved and a higher percentage of effort is devoted to nonpoint source concerns, which are frequently quite complex, the CRP can play an even larger role.

APPENDIX A

STEERING COMMITTEE MEMBERS

APPENDIX A

CLEAN RIVERS PROGRAM
STEERING COMMITTEE FOR
THE LAVACA-GUADALUPE COASTAL BASIN
AND
THE GUADALUPE RIVER BASIN

Upper Basin Subcommittee:
Kendall County: James W. "Bill" Gooden, County Judge; Patrick R. Heath, Mayor of Boerne; Arthur Nagle, Riverside and Landowners Protection Coalition; Edgar Schwarz, Jr., A.C. Schwethelm; and Barry Brandenburger, Manager of the Kendall County Water Control & Improvement District No. 1.
Blanco County: Charles Scott, County Judge; Ryan Trimble, Mayor of Blanco; Terry Rogers, Superintendent of Blanco State Park; and Paul DuBose, Friends of the Little Blanco.
Kerr County: Bob Denson, County Judge; Charles Johnson, Mayor of Kerrville; Harold Wunsch, Mayor of Ingram; George Holckamp, Chairman of the Kerr County Soil and Water Conservation District; Jeanne West, President of the League of Women Voters; and Richard G. Eastland of Camp Mystic.

Upper Middle Basin Subcommittee:
Comal County: Carter Casteel, County Judge; Paula DiFonzo, General Manager New Braunfels Utilities; and Curtis Bremer, rancher.
Guadalupe County: James L. Sagebiel, County Judge; Henry Aubel, City of Seguin Councilman; and Michael S. Peters, Assistant to Vice-President of Operations at Structural Metals Incorporated.
Hays County: Dr. Glenn Longley, Director of the Edwards Aquifer Research and Data Center; and Steve Fonville of the San Marcos River Watch.

Lower Middle Basin Subcommittee:
Caldwell County: Randy Thomas, Luling City Manager; and Archie Abrameit, Manager of the Luling Foundation.
DeWitt County: Ben E. Prause, County Judge; Michael Thamm, Mayor of Cuero; and Jim Springs, Manager of DeWitt County Electric Cooperative.
Gonzales County: Calvin Spacek, City of Gonzales; and John Pritz, Economic Development Representative with the Guadalupe Valley Electric Cooperative.

Lower Basin Subcommittee:
Calhoun County: Howard G. Hartzog, County Judge; J.R. Hattalora, Environmental Protection Department Head at Union Carbide; and Dan Yanta, District Conservationist with the Natural Resources Conservation Service.
Refugio County: Charlie Stone, County Judge; and Loretta Bourland, President of the Refugio Chamber of Commerce.
Victoria County: James C. Frank, an environmental consultant with E.I. Dupont.

Executive Committee:
Patrick R. Heath, Mayor of Boerne; Paul DuBose, Friends of the Little Blanco; George Holehamp, President of the Kerr County Soil and Water Conservation District; Curtis Bremer, rancher; Henry Aubel, City of Seguin Councilman; Steve Bonville of the San Marcos River Watch; Archie Abrameit, Manager of the Luling Foundation; Jim Springs, Manager of DeWitt County Electric Cooperative; J.R. Battalora, Environmental Protection Department Head at Union Carbide; and James C. Frank, an environmental consultant with E.I. Dupont.

Representatives to all committees are: Jack Ralph, Texas Parks and Wildlife Department; Gordon Thorn, Texas Water Development Board; Peter Samuels, Texas General Land Office; Roy Freeman, Texas State Soil and Water Conservation Board; Windle Taylor, Texas Railroad Commission; Scott Loveland, UGRA; J.T. Brown, General Manager, UGRA; Paul Jensen, Espey, Huston & Associates, Inc.; and James T. Arnst, Director of Water Quality Services at GBRA.

APPENDIX B

PUBLIC INVOLVEMENT MATERIALS

APPENDIX C

BRUSH CONTROL

INTRODUCTION

Water and cedar are two common topics of conversation anywhere in the Texas Hill Country. "When will we get some more rain", or "When will we get some relief from cedar fever" are questions asked throughout this part of Texas on a daily basis. These two entities sometimes seem far removed from one another, however they are intimately related.

Several threatened or endangered species in this part of Texas are dependent upon both of these resources for their survival. The golden-cheeked warbler (*Dendroica chrysoparia*) uses only the bark from mature cedar (also known as juniper, *Juniperus ashei*) to construct its nest, while the springs that feed the San Marcos and Comal rivers are important to threatened and endangered species such as the fountain darter (*Etheostoma fonticola*), San Marcos gambusia (*Gambusia georgei*), San Marcos salamander (*Eurycea nana*), Texas blind salamander (*Typhlomolge rathbuni*), and Texas wild-rice (*Zizania texana*).

Both are equally important to humans in this region as well. Cedar is most often considered a nuisance by most, causing allergies during the winter months and limiting rangeland productivity. The importance of water to this region almost goes without saying, as this area supports a rapidly growing population and a diverse industrial and agricultural community as well.

Recent research is currently finding more common bonds between these two. The presence of invasive brush species, like cedar, appears to have an effect on watershed resources as well. With the increasing concern for water resources, and a growing need for water conservation in this part of the state, the possibility of increasing watershed quality by careful removal of cedar needs a prudent examination.

While the majority of the information presented in this document deals with the problem of invasive cedar within the Hill Country, it is understood that invading brush species are not limited to this region of Texas. The Guadalupe River watershed crosses several distinct ecological areas, and brush invasion may be a problem in each (i.e., honey mesquite (*Prosopis glandulosa*) and huisache (*Acacia smallii*) are encroaching into grassland areas to the south of the Edwards Plateau).

The effects of this increase of woody vegetation in other areas of Texas on groundwater supply are poorly understood; nevertheless, sound range management deems careful control of these species as well. Many of the practices presented in this document have application in areas of Texas besides the Edwards Plateau; however, many of the variables differ from region to region and further information may be needed prior to the implementation of a brush control program. As much of the water supply for the basin originates in the Edwards Plateau, this area has the greatest potential for increased supply through careful brush management.

HISTORICAL PERSPECTIVE OF THE SOUTHEASTERN EDWARD'S PLATEAU

Many have speculated what the landscape in this part of Texas was like prior to Spanish and European settlement. Most authorities are content to say that the vegetation was considerably different than it is at present. The species present have not appeared to change; however, the vegetative composition of this region has undergone some changes.

Historically, this region of Texas was most likely a link between the eastern forests of the United States and the forests and woodlands of Northeast Mexico (Weniger, 1988). While it is impossible to know the exact composition of this region, it is hypothesized that woody plant density was considerably lower prior to Spanish settlement. Early descriptions of this region often depict a landscape that was covered with dense stands of grasses, dotted with mottes of trees. Woody species were dominant in the stony uplands, along riparian zones, and in areas of high relief (Bray, 1904; Olmsted, 1978; Roemer, 1935; Amos and Gehlbach, 1988).

The density of cedar during this time may never be known; however, there are descriptions of dense "cedar-brakes" in areas. These cedar-brakes are thought to have been most common on canyon slopes where the soil is much shallower (Smeins et al., 1994).

The current landscape reflects a change in vegetation, and a transition from a savannah to a shrubland may be seen. Many species of woody plants have encroached into these grasslands; however, cedar appears to be the most successful. Cedar is no longer confined to dense stands in canyons, it has moved into the grassy areas and has begun to form dense stands in areas previously dominated by grassland (Fonteyn et al, 1988). The exact cause for this increase in the density and distribution of cedar is difficult to understand due to the fact that several factors may be linked to increasing cedar populations.

Changing land use patterns seem to be the most important factor linked to increasing cedar density. Overgrazing and suppression of fire are the two most likely explanations for this marked increase (Smeins et al., 1994; and others). Overgrazing drastically reduces the amount of herbaceous cover, which leads to reduced competition between cedar seedlings and grasses or forbs. This decline in herbaceous cover also reduces the fuel load for naturally occurring fires. This reduced fuel load and suppression of natural fires also played a major role in the increase of cedar densities.

RELATIONSHIP BETWEEN CEDAR AND RANGELAND WATERSHEDS

Almost 40% of the world's land surface may be classified as rangeland; land that is generally better suited for grazing than farming or timber production (Hibbert, 1983 and Branson et al., 1981). Rangelands produce a wide variety of resources important to man, such as livestock, wildlife habitat, recreational opportunities, and water. Rangelands are elemental in the production of quality water for industrial, domestic, and agricultural purposes, since they typically make up considerable portions of the watershed (Branson et al., 1981). It is for this reason that rangelands are vital to healthy watersheds; they must not only provide forage and water for animals, but they must be managed to produce quality water for recharging underground aquifers, springs, streams, and rivers (Thurow and Carlson, 1994).

Research investigating the relationships between water balance and the vegetation on rangelands began many years ago. Many of these studies concentrated on areas in the western United States; however, recent studies concerning woody species and their relationship to watersheds have commenced in Texas as well.

Researchers at the Seco Creek Water Quality Demonstration Project located in Uvalde County have been examining the effects of cedar removal on water quantity for several years (Dugas and Hicks, 1994). Studies conducted by the Texas State Soil and Water Conservation Board (SSWCB) have also explored the relationships between brush invasion and its effects on water resources (SSWCB, 1991).

The results of these studies are similar to those found by many researchers in the western portions of the United States; watershed quality may be improved by careful brush management. This should be of particular interest to land managers throughout the Guadalupe-Blanco River watershed, as brush removal (especially re-growth cedar) also may enhance range condition as well as wildlife resources.

Preliminary results from cedar removal studies on the Seco Creek watershed confirm lower evapotranspiration rates on areas where cedar had been removed. It is hypothesized that this water savings would increase water supplies in the Edwards aquifer by approximately 7% (Dugas and Hicks, 1994). Another benefit of removal of cedar may be restoration of flows to historic springs. Preliminary information on the removal of immature cedar on the discharge of a spring near Hondo, Texas suggest a 16% increase in spring flow. Estimates on water savings in the Edwards Plateau from brush control composed by the SSWCB (1991), imply a savings of 1,192,925 acre feet of water at a 50% treatment rate. These results, though precursory and encompassing relatively small areas, provide useful insight to the benefits of a well planned brush control program throughout the Guadalupe-Blanco River watershed.

Cedar control programs must be well planned, and it is important to keep in perspective that most of the current information encompasses small localities. The long-term effects of large scale removal of unwanted brush species still needs further research to determine these effects as applied to entire watersheds.

When invasive brush species, such as cedar, are replaced by herbaceous vegetation, such as grasses, it is generally understood that infiltration rates increase as run-off rates decrease. Both are beneficial to the watershed. Increased infiltration leads to increased amounts of water available for recharging ground water supplies, and decreased run-off helps conserve precious amounts of the limited supply of soil in the Edwards Plateau. Planning should include steps to limit soil loss after removal of unwanted brush species.

While the actual amount of water saved may never be known, it is important to keep in perspective the health of the ecosystem. A healthy ecosystem will not only provide sufficient amounts of habitat and forage for wildlife and cattle, but will provide adequate water for recharge of our dwindling groundwater as well. Land managers may benefit from brush control programs in many ways. Increased amounts of useful rangeland lead to increased revenues from livestock production. Increased revenue may also be observed from the consumptive and non-consumptive uses of wildlife. Healthy groundwater supplies, livestock and wildlife when managed with an integrated approach, are all compatible and have direct economic implications to persons who reside in this part of Texas.

TECHNIQUES FOR CEDAR CONTROL

It is understood that under normal circumstances, most livestock are reluctant to consume large amounts of cedar. This is due in part to the chemical nature of the foliage. This hesitance in cedar consumption is partially responsible for the gradual change towards a cedar woodland (Huston et al., 1994). By controlling the cover and density of cedar, it is possible to enhance the range condition and increase the carrying capacity. However, it is important to remember that high stocking rates and poor grazing management are partially to blame for this problem in the first place. Careful planning on all aspects of range management should be followed to produce quality livestock and a healthy range. Current innovations in grazing systems show much promise for increased production of livestock as well as producing a sustainable and healthy ecosystem (Savory, 1988).

Without question, the mention of cedar removal creates anxiety among many landowners in the Hill Country. In this part of Texas, endangered species and their habitats need to be incorporated into land management plans. Does this mean that land managers can not clear blocks of unwanted cedar? No. Currently, stands of cedar with an average height of less than 12 feet do not compose suitable habitat for the endangered golden-cheeked warbler, and are legal to clear. The United States Fish and Wildlife Service (USFWS) has no guidelines on canopy cover or tract size, and decisions on clearing often are based on locations of other warbler populations, hardwood species associated with the cedar stand, age of the cedar individuals within the stand, and past land use practices (43 FR 53156 and Rollins and Armstrong, 1994).

Nesting habitat for the golden-cheeked warbler is best described as an Ashe juniper-oak woodland, with older age class junipers forming the dominant layer of vegetation. Deciduous species such as live oak (*Quercus fusiformis*), Texas oak (*Q. buckleyi*), cedar elm (*Ulmus crassifolia*), hackberry (*Celtis* sp.), and sycamore (*Platanus occidentalis*) often compose the remaining woody community. Many times the canopy of this habitat is almost closed, as these endangered birds prefer areas with dense foliage and high tree density (USFWS, 1992).

In many areas, this particular habitat occurs on the steep slopes of canyons common throughout the eastern edge of the Edward's Plateau (although suitable habitat may occur wherever the proper conditions exist). These areas offer poor productivity for livestock operations, and are generally not cleared to prevent soil erosion. It is here, in these canyons, that cedar has its place in the ecosystem.

Cedar is important to other wildlife resources in the Edwards Plateau as well. With the growing potential for increased revenue generation from consumptive and non-consumptive uses of wildlife in this part of the state, the effects of brush control on wildlife need careful consideration as well. Cedar provides shelter for many species of wildlife. Cedar may also provide wildlife with food on a seasonal basis as well. Cedar browse is considered marginal at best by most experts; however, deer are still known to consume significant portions. Generally, deer utilize cedar browse during the winter or on poor range sites (Rollins and Armstrong, 1994). Cedar berries may also serve as an important food supply for many small mammals and song birds (Martin et al., 1961).

Large, monoculture cedar stands are not favorable for wildlife or livestock. Even the endangered golden-cheeked warbler prefers a mixed cedar-oak community (Kroll, 1980). Cedar control programs should concentrate on increasing forage production and ease of handling of livestock, but still maintain cover for wildlife.

There is sufficient evidence to support a cedar management program in order to enhance watershed quality and overall range condition. However, the most important aspect of this concept is how to go about accomplishing this task. Planning must precede any form of brush control program.

Proper grazing management has been identified as the primary tool for the management of cedar and other invasive brush species (Ueckert et al., 1994). Proper stocking rates and periodic rest increase the cover and vigor of herbaceous species. This allows more desirable species to better compete with emerging cedar seedlings. Proper grazing management allows for pressure on the weakest link in the life cycle of cedars, and moves the competitive advantage towards desirable forage plants.

Proper use of grazing is also important for the use of another management option, controlled burning. Proper grazing and recovery is needed to provide the fuel needed to carry a fire. Historically, fire was the ecological factor which prevented cedar invasion into grassland areas and confined them to canyons and limestone outcrops. Fire is an economical means of controlling cedar as well. While initial costs may range as high as $10 per acre, the costs of follow-up burns drops substantially (White and Hanselka, 1989). It is important to remember that controlled burning should be cyclic, and concentrate on the weaker portions of the cedar life cycle (i.e., cedar saplings less than 4 feet in height) (Ueckert, et al., 1994).

By using a long-term controlled burning plan, it is possible to burn portions of a given ranch each year. Pastures destined for a burn are deferred from the grazing rotation in order to increase fuel loads for adequate mortality of immature cedar. Wildlife may also benefit from this deferred grazing, as many species of savannah or grassland species may utilize this habitat. This type of rotating fire management integrates well with many of the rotational grazing systems currently in use.

Mechanical methods of cedar control also have application in this part of Texas. Chaining, dozing, and hand clearing have all been used to control cedar in the past, and are still useful, provided they are economically and ecologically feasible. It is important to keep in mind that certain "heavy" mechanical practices (such as dozing) may have adverse effects due to the soil disturbance, compaction, and increased erosion potential. This type of disturbance may have a negative impact on the hydrology of a given site, leading to increased run-off and sedimentation (Thurow and Carlson, 1994).

Combinations of mechanical and burning techniques are sometimes needed in order to eliminate certain stands of noxious brush; however, site hydrology may also be adversely affected, especially when moderate or steep slopes are treated by these means (Thurow and Carlson, 1994). Wright et al. (1976) found that tree-dozing/burning on slopes less than 20% produced no significant soil or water quality losses, and suggest that areas with greater slope be left as wildlife cover/habitat.

Certain chemical herbicides may have application to cedar control. Picloram and picloram in combination with 2,4-D are effective in cedar control, but concerns about off-site runoff and possible contamination of groundwater should not be overlooked (Thurow and Carlson, 1994).

Generally speaking, clearing should be done in irregular patterns instead of rectangular or square plots, and more desirable species, such as oaks, should be left. Following the natural contours of the land and preserving stands of woody vegetation in drainage areas and other localities with slope will not only reduce the amount of runoff and sedimentation, but will enhance wildlife habitat as well (Rollins and Armstrong, 1994; Wright et al., 1976).

EXISTING PROGRAMS FOR ASSISTANCE WITH BRUSH CONTROL

There are several forms of assistance available to landowners interested in brush control programs. A brief summary follows.

The Texas Parks and Wildlife Department (TPWD) offers the Private Lands Enhancement Program (PLEP) free of charge to landowners interested in improving the quality of wildlife resources on their property. The program is currently available statewide, and includes a personal meeting with a TPWD biologist and property inspection. The landowner determines the management goals for the tract and the biologist provides the technical knowledge and recommendations needed to achieve these objectives, usually in the form of a written management plan. While not directly aimed at brush control, native habitat restoration is a wildlife management goal that is entirely consistent with brush control.

The Natural Resource Conservation Service (NRCS; formally the Soil Conservation Service (SCS)) offers similar guidance with a greater degree of emphasis on improving rangeland productivity and quality. Under the Annual Agriculture Conservation Program, a management plan for a ranch or farm can be generated, and management options will be included. Some financial assistance may be available for certain practices, such as brush control or native grass re-seeding efforts.

The United States Department of Agriculture (USDA) offers some financial assistance through the Agricultural Conservation Program (ACP). The ACP is designed to curtail soil erosion, decrease water pollution, protect and improve range and farm lands, conserve water destined for agricultural purposes, preserve and develop wildlife habitat, and promote energy conservation measures. Interested parties should contact the Consolidated Farm Service Agency (CFS) for further information.

Most of the financial assistance available from the various agencies varies. At this writing (March 1996) the federal budget status is uncertain, so direct contact is encouraged.

SUMMARY

There is the potential for improving the quality of the watershed through careful management of cedar. This type of management, when done in an economically and ecologically sound manner, has great potential for range improvement, improvement of wildlife resources, as well as water conservation. Current research has shed new light on many beneficial range management practices, such as controlled burning, mechanical removal, and combinations of these to allow land managers choices for improving range quality.

While endangered species are a concern and should not be ignored, managers should not be discouraged or frightened by regulations placed on cedar removal as long as USFWS guidelines are followed. By applying ecosystem concepts to land management, managers will not only see improvement of range condition, but increases in wildlife as well. Currently wildlife is a valuable resource to managers in the Edwards Plateau. Revenue is not only generated from consumptive activities, such as hunting, but non-consumptive activities such as bird watching and wildlife photography, have great potential for increased income as well. This added income may help off-set the cost involved in a comprehensive management scheme for landowners, including cedar control measures.

When these approaches are taken over a wide area, such as the Guadalupe-Blanco River watershed, many will benefit. Replacing invasive brush species with grasses and forbs beneficial to wildlife and livestock not only improves the condition of the land on a small scale, but is beneficial to neighboring properties as well. Land managers are faced with interesting challenges; not only must they produce a way of life for their families, but be responsible stewards of the whole as well. Each manager has a part of the whole, and it is important to think beyond the boundaries of fences.

FOR FURTHER INFORMATION CONTACT:

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Natural Resource Conservation Service (NRCS)
County Field Offices

DeWitt County
Cuero Field Office
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1119 North Esplanade
Cuero, TX 77954
(512) 275-5293

Kendall County
Boerne Field Office
District Conservationist: William T. Bolzle
430 West Bandera, #26
Boerne, TX 78006-0108
(210) 249-2821

Guadalupe County
Seguin Field Office
District Conservationist: Gary R. Rainwater
210 E. Liveoak, Room 207
Seguin, TX 78155-6421
(210) 379-0930

Caldwell County
Lockhart Field Office
District Conservationist: Isidro Y. Morales, Jr.
1400-D FM Hwy. 20 East
Lockhart, TX 78644-2126
(512) 398-2121

Comal County
New Braunfels Field Office
District Conservationist: Carl F. Englerth
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555 IH 35 West, Suite 248
New Braunfels, TX 78130-4879
(210) 625-5611

Victoria County
Victoria Field Office
District Conservationist: E. Douglas Neel
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Federal Building, Room 308
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Blanco County
Johnson City Field Office
District Conservationist: Bertha T. Venegas
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(210) 868-7237

Kerr County
Kerrville Field Office
District Conservationist: Rex C. Brand
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Kerrville, TX 78028-5215
(210) 896-4911

Gonzales County
Gonzales Field Office
District Conservationist: Oren C. Remmers
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Room 1142
Gonzales, TX 78629-3533
(210) 672-8371

Hays County
San Marcos Field Office
District Conservationist: Marion O. Johnson
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Goliad County
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APPENDIX D

REGIONAL WATER QUALITY ASSESSMENT

APPENDIX D

REGIONAL WATER QUALITY ASSESSMENT

In order to address the Clean Rivers Program (CRP) objectives to the extent possible, this biennial assessment includes an analysis of available water quality data. This data analysis task follows procedures specified in the Program Guidance issued by the TNRCC. The Guidance includes the following six steps:

1. Preliminary Evaluation,
2. Primary Screening,
3. Secondary Evaluation,
4. Secondary Screening,
5. Water Quality Concerns Evaluation, and
6. Identification of Causes of Water Quality Concerns.

The following subsections provide a detailed description of the data analysis conducted for the Guadalupe River and Lavaca-Guadalupe Coastal Basins. Figure D1-1 shows the segments in the two basins and the principal geographic features.

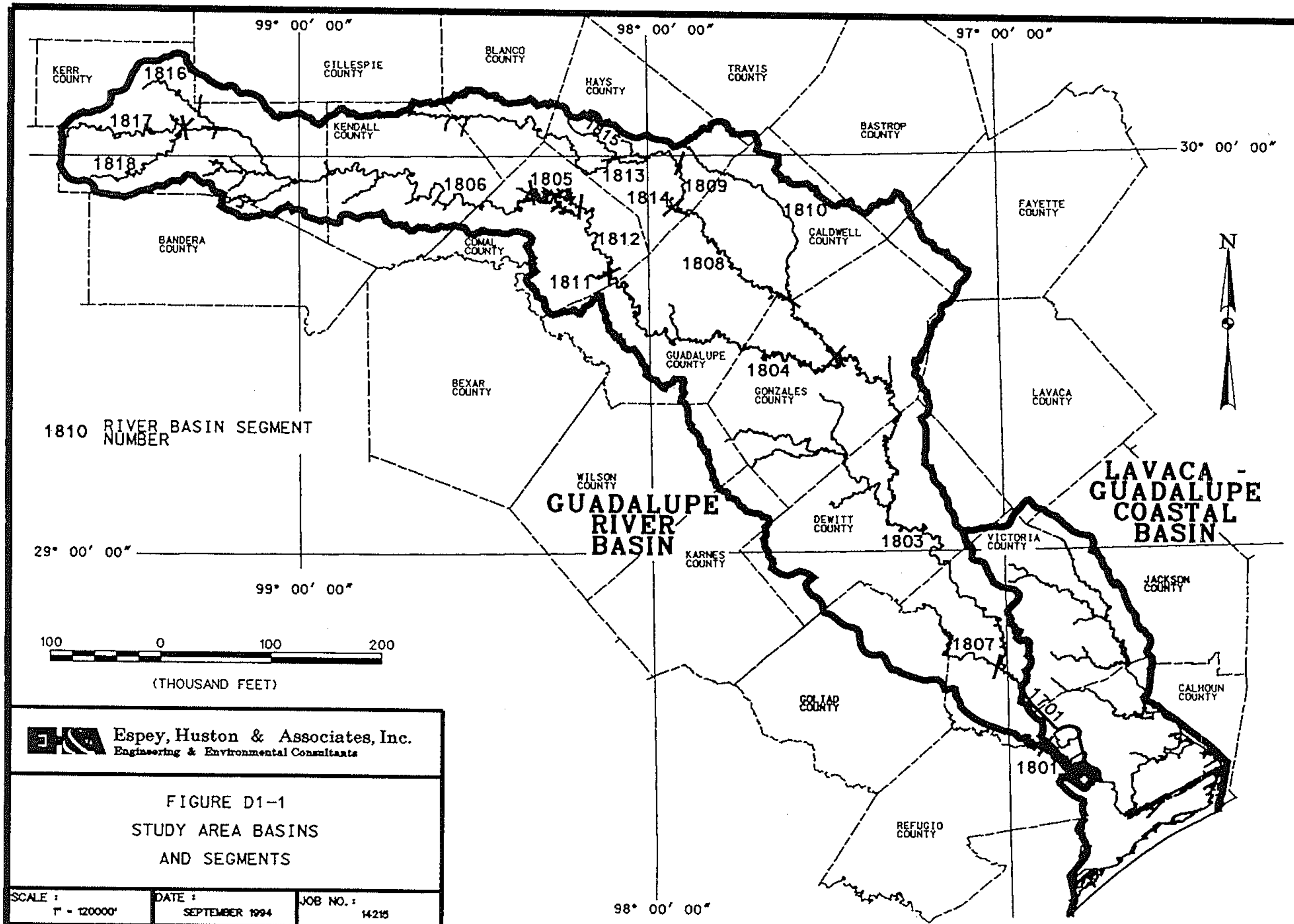
Step 1 - Preliminary Evaluation

The objective of Step 1 data analysis is to determine whether a specific data set should be included or excluded in the analysis. The Guidance suggests that the following questions be asked:

a. By what methods were the data collected?

b. Which laboratory or laboratories analyzed the samples, or what analytical methods were used, and is there any reason to question the accuracy or precision of the analysis?

c. What was the objective in sampling for these data, and how does the objective relate to the goals of the CRP analysis?



Espey, Huston & Associates, Inc.
Engineering & Environmental Consultants

FIGURE D1-1
STUDY AREA BASINS
AND SEGMENTS

SCALE :	DATE :	JOB NO. :
1" - 120000'	SEPTEMBER 1994	14215

FILE: I:\projects\eeng\gbra\basn_seg.dgn
DATE: 01-Jul-96 13:44

There are four major data sources for the Guadalupe River Basin: TNRCC, USGS, GBRA and UGRA. The TNRCC and USGS data were provided in Paradox format by TNRCC and there is no doubt that they should be included in the analysis.

The GBRA and UGRA data were collected for the same basic purpose as the TNRCC and USGS data. Sampling and analytical work were performed by trained professionals and both laboratories are active participants in the Texas Water Utilities Laboratory Analyst Section (TWUA/LAS) training and QA/QC protocols. In general, the sampling objectives, analytical methods and QA protocols are consistent with the CRP goals. Based on this, these data are considered acceptable for inclusion in the analysis.

The data sources, segments, covered, and time periods are shown in Table D1-1.

Note that the purpose of step 1 is not to detect errors, typos, outlier, etc. in a specific data set. This is handled in a separate step. Rather, Step 1 is simply to determine whether a data set should be included or excluded from analysis. With that requirement, all data received from the TNRCC, USGS, GBRA and UGRA are included in the following data analysis steps.

Step 2 - Primary Screening

This step screens water quality data by parameter and by segment, in relation to screening criteria, in order to classify each parameter-segment into one of the four categories:

Insufficient Data (ID),
No detectable Concern (NC),
Possible Concern (PC), and
Concern (C).

The screening criteria used in the classification are listed in Table D2-1, reproduced from the TNRCC Guidance Document. The screening criteria are set in a conservative fashion, such as a fraction of a regulatory value, on the theory that it is better to identify something that is not really a problem than it is to overlook a real problem or concern. While a conservative approach to any activity is generally desirable, the reader should be aware of some aspects discussed below.

TABLE D1-1
DATA SOURCES AND RANGES

Segment ID	Station ID	Number of Data	Data Range From	Data Range To	Segment ID	Station ID	Number of Data	Data Range From	Data Range To
Basin 18 - Data Source: GBRA					***Basin 18 - Data Source: TNRCC***				
1803	12578	718	03/24/87	02/12/96	1807	12622	283	10/22/81	10/24/95
1803	12592	490	05/29/90	02/12/96	1808	12553	22	04/13/82	04/13/82
1804	12596	618	03/23/87	02/13/96	1808	12624	192	05/11/88	10/23/95
1805	12598	451	03/23/87	02/13/96	1808	12628	378	10/21/81	10/17/95
1807	12623	534	03/24/87	11/23/97	1809	12630	38	06/03/85	06/04/85
1808	12626	649	03/23/87	02/13/96	1809	12631	77	08/09/83	10/17/95
1811	12653	116	11/30/94	02/13/96	1809	12632	65	06/03/85	06/04/85
1812	12658	568	03/23/87	02/13/96	1809	12633	39	08/09/83	06/04/85
Basin 18 - Data Source: TNRCC					1809	12634	34	06/03/85	06/04/85
1801	12577	911	10/09/81	11/09/95	1809	12635	31	06/03/85	06/04/85
1803	12554	20	04/13/82	04/13/82	1809	12636	32	06/03/85	06/04/85
1803	12578	19	04/15/85	04/15/85	1809	12637	329	10/21/81	06/21/93
1803	12579	28	10/05/82	10/05/82	1810	12538	21	08/25/92	06/21/94
1803	12580	5	10/05/82	10/05/82	1810	12555	66	09/06/83	09/09/87
1803	12581	462	12/29/81	04/13/94	1810	12556	44	09/06/83	09/09/87
1803	12582	5	10/05/82	10/05/82	1810	12557	59	09/06/83	09/09/87
1803	12583	5	10/05/82	10/05/82	1810	12558	1	09/07/83	09/07/83
1803	12584	9	10/05/82	10/05/82	1810	12559	1	09/07/83	09/07/83
1803	12585	9	10/05/82	10/05/82	1810	12638	38	09/06/83	09/07/83
1803	12586	5	10/05/82	10/05/82	1810	12640	498	01/15/82	10/09/95
1803	12587	7	10/05/82	10/05/82	1810	12641	59	09/06/83	09/09/87
1803	12588	9	10/05/82	10/05/82	1810	12642	76	09/06/83	07/23/91
1803	12589	9	10/05/82	10/05/82	1810	12643	60	09/06/83	09/09/87
1803	12590	22	10/05/82	10/05/82	1810	12644	65	09/06/83	09/09/87
1803	12591	381	01/27/82	07/06/95	1810	12645	63	09/06/83	09/09/87
1804	12575	82	11/03/88	07/25/91	1810	12646	36	09/06/83	09/07/83
1804	12576	268	06/29/88	06/06/90	1810	12647	64	09/06/83	09/09/87
1804	12595	345	09/13/83	05/11/89	1810	12648	63	09/06/83	09/09/87
1804	12596	370	01/15/82	07/25/94	1810	12649	1	09/07/83	09/07/83
1805	12598	309	11/10/81	08/24/94	1810	12650	1	09/07/83	09/07/83
1805	12600	304	11/10/81	08/24/94	1811	12569	18	07/09/86	07/09/86
1805	12601	294	11/10/81	08/24/94	1811	12570	30	07/08/86	07/09/86
1806	12551	20	11/01/83	11/01/83	1811	12571	29	05/10/88	08/22/88
1806	12562	40	11/01/83	11/01/83	1811	12572	31	07/08/86	07/09/86
1806	12563	53	11/01/83	11/01/83	1811	12573	18	07/08/86	07/08/86
1806	12564	42	11/01/83	11/01/83	1811	12574	17	07/08/86	07/08/86
1806	12603	256	05/25/84	01/24/94	1811	12651	29	07/08/86	07/09/86
1806	12604	123	10/20/81	02/06/84	1811	12652	41	01/18/82	08/18/87
1806	12606	33	11/01/83	11/01/83	1811	12653	358	10/21/81	09/28/95
1806	12609	35	11/01/83	11/01/83	1811	12654	26	07/08/86	07/09/86
1806	12610	36	11/01/83	11/01/83	1811	12655	27	07/08/86	07/09/86
1806	12611	34	11/01/83	11/01/83	1812	12656	268	05/02/83	09/28/95
1806	12612	57	11/01/83	11/01/83	1812	12657	82	10/21/81	06/22/83
1806	12613	40	11/01/83	11/01/83	1812	12658	13	03/22/84	03/22/84
1806	12615	37	11/01/83	11/01/83	1813	12537	7	08/11/83	08/11/83
1806	12616	32	11/01/83	11/01/83	1813	12539	7	08/11/83	08/11/83
1806	12621	20	11/01/83	11/01/83	1813	12540	150	09/24/88	03/22/89
1806	14255	29	11/09/94	08/21/95	1813	12560	232	06/29/88	11/17/93
1807	12568	175	01/27/82	08/24/88	1813	12561	15	11/01/83	11/01/83

TABLE D1-1 (Concluded)
DATA SOURCES AND RANGES

Segment ID	Station ID	Number of Data	Data Range From	Data Range To
Basin 18 - Data Source: TNRCC				
1813	12567	1	01/01/00	08/10/83
1813	12659	7	01/07/00	08/11/83
1813	12660	13	01/13/00	08/11/83
1813	12661	351	12/16/00	10/21/81
1813	12662	7	01/07/00	08/11/83
1813	12663	5	01/05/00	08/11/83
1813	12664	7	01/07/00	08/11/83
1813	12665	7	01/07/00	08/10/83
1813	12666	6	01/06/00	08/10/83
1813	12667	6	01/06/00	08/10/83
1813	12668	14	01/14/00	08/10/83
1813	12669	82	03/22/00	08/05/92
1813	12670	7	01/07/00	08/10/83
1814	12671	215	08/02/00	01/27/86
1814	12672	45	02/14/00	07/14/92
1814	14153	20	01/20/00	07/14/92
1815	12673	6	01/06/00	08/11/83
1815	12674	296	10/22/00	08/12/82
1815	12675	2	01/02/00	08/11/83
1815	12676	6	01/06/00	08/10/83
1815	12677	6	01/06/00	08/10/83
1816	12678	112	04/21/00	11/01/83
1817	12681	115	04/24/00	02/22/88
1818	12685	116	04/25/00	02/22/88
Basin 18 - Data Source: UGRA				
1806	12541	511	10/23/81	11/14/95
1806	12542	31	07/12/94	08/08/95
1806	12543	447	10/23/81	11/14/95
1806	12544	385	10/23/81	11/14/95
1806	12545	58	10/23/81	04/12/84
1806	12546	560	10/23/81	11/14/95
1806	12547	437	10/23/81	03/21/95
1806	12548	94	10/23/81	04/07/86
1806	12549	499	10/23/81	11/14/95
1806	12550	36	05/23/94	12/06/94
1806	12551	444	01/16/84	11/14/95
1806	12552	204	10/23/81	12/06/94
1806	12562	381	06/08/88	06/20/89
1806	12563	486	12/16/86	03/21/90
1806	12564	314	06/08/88	11/14/95
1806	12565	266	01/16/84	03/21/95
1806	12566	175	06/08/88	11/14/95
1806	12602	119	06/12/88	05/16/89
1806	12604	99	10/23/81	01/15/86
1806	12605	457	10/23/81	11/14/95
1806	12606	6	03/21/95	03/21/95
1806	12607	282	02/06/84	05/22/91
1806	12608	456	10/23/81	11/14/95
1806	12609	223	10/16/85	06/20/89

Segment ID	Station ID	Number of Data	Data Range From	Data Range To
Basin 18 - Data Source: UGRA				
1806	12610	344	12/09/85	12/14/93
1806	12611	574	10/23/81	11/14/95
1806	12612	601	12/18/84	05/22/91
1806	12613	487	03/20/85	11/16/89
1806	12614	313	06/08/88	06/20/89
1806	12615	579	05/09/88	11/14/95
1806	12616	446	10/16/85	11/14/95
1806	12617	97	10/23/81	01/15/86
1806	12618	799	10/23/81	11/14/95
1806	12619	464	06/11/84	11/14/95
1806	12620	716	10/23/81	11/14/95
1806	12621	443	10/23/81	11/14/95
1816	12678	461	01/16/84	11/14/95
1816	12679	151	10/23/81	12/06/94
1816	12680	94	10/23/81	01/15/86
1817	12681	372	10/23/81	11/14/95
1817	12682	180	10/23/81	11/14/95
1817	12683	198	10/23/81	11/14/95
1818	12684	371	10/23/81	11/14/95
1818	12685	83	10/23/81	01/15/86
1818	12686	218	10/23/81	11/14/95
1818	12687	107	10/23/81	03/21/95
1818	12688	255	10/23/81	11/14/95
Basin 18 - Data Source: USGS				
1803	12578	419	11/18/81	08/30/94
1803	12585	486	11/19/81	08/25/94
1803	12593	185	10/07/81	08/15/85
1803	13657	366	10/06/81	08/29/94
1804	12596	317	10/20/81	09/02/94
1805	13838	21	01/20/93	08/24/94
1805	13839	20	01/20/93	08/24/94
1805	13840	20	01/20/93	08/24/94
1805	13841	65	01/20/93	08/24/94
1805	13842	20	01/20/93	08/24/94
1805	13843	61	01/20/93	08/24/94
1806	13700	296	10/14/81	09/02/94
1808	12626	315	10/05/81	09/06/94
1810	12642	184	11/16/81	06/24/86
1812	13656	190	10/21/81	08/24/94
1813	12661	166	02/18/88	08/30/93
Basin 17 - Data Source: TNRCC				
12534	2453	256	06/08/82	09/19/95
12535	1701	16	07/06/82	02/09/84
12536	1701	502	10/27/81	10/16/95
Basin 24 - Data Source: USGS				
13291	2453	295	02/09/82	08/10/88

TABLE D2-1
SUMMARY OF PRIMARY SCREENING METHODS PROVIDED BY TNRCC

Parameter	Screening Criteria for: Classified Segments	Screening Criteria for: Unclassified Waterbodies	No. of Exceedences Which Require Proceeding to Secondary Screening	Measurements Evaluated
Temperature	TSWQS	No analysis	≥ 10%	Surface Measurements Only
pH	TSWQS	TSWQS of 1st downstream classified segment	≥ 10%	All Measurements
Conductivity/TDS	TSWQS for TDS x 0.75	TSWQS x 0.75 of 1st downstream classified segment unless downstream segment is saltwater; then, no analysis	≥ 10%	All Measurements
Cl and SO_4	TSWQS x 0.75	TSWQS x 0.75 of 1st downstream classified segment unless downstream segment is saltwater; then, no analysis	≥ 10%	All Measurements
DO	Spring mean criteria for aquatic life use designated in TSWQS	5.5 mg/L in fresh water and 5.0 mg/L in salt water unless aquatic life use has been determined; then, spring mean criteria for that aquatic life use	≥ 10%	For streams, surface measurements only; for reservoirs/lakes and ship channels, all measurements made from the epilimnion.
Fecal Coliform	TSWQS x 2	400 organisms/100 ml	≥ 10%	Surface Measurements Only

TABLE D2-1 (Concluded)
SUMMARY OF PRIMARY SCREENING METHODS PROVIDED BY TNRCC

PARAMETER	SCREENING CRITERIA FOR: CLASSIFIED SEGMENTS		SCREENING CRITERIA FOR: UNCLASSIFIED WATERBODIES		NO. OF EXCEEDENCES WHICH REQUIRE PROCEEDING TO SECONDARY SCREENING	MEASUREMENTS EVALUATED
TEMPERATURE	TSWQS		No analysis		≥ 10%	Surface Measurements Only
NUTRIENTS: FRESH WATER	NO_3 - N NO_2 + NO_3 - N NH_3 - N Organic N Total N Total P	1.0 mg/L 1.0 mg/L 1.0 mg/L 2.0 mg/L 3.0 mg/L 0.2 mg/L	NO_3 - N NO_2 + NO_3 - N NH_3 - N Organic N Total N Total P	1.0 mg/L 1.0 mg/L 1.0 mg/L 2.0 mg/L 3.0 mg/L 0.2 mg/L	≥ 10% for any of the parameters	All Measurements
SALT WATER	NO_3 - N NH_3 - N Dissolved P o-PO_4-P Total P	0.4 mg/L ? 0.2 mg/L 0.2 mg/L 0.4 mg/L	NO_3 - N NH_3 - N Dissolved P o PO_4-P Total P	0.4 mg/L ? 0.2 mg/L 0.2 mg/L 0.4 mg/L	≥ 10% for any of the parameters	All Measurements
METALS AND CYANIDE	Use 0.75 times most stringent value from Table 1 or Table 3 of TSWQS. If a hardness value is needed to calculate criteria, use value in Table 2 of TSWQS.		Use 0.75 times most stringent value from Table 1 or Table 3 of TSWQS. If a hardness value is needed to calculate criteria, use value in Table 2 of TSWQS.		≥ 1	All Measurements (total or dissolved)
ORGANICS	Detection limit		Detection limit		≥ 1	All Measurements

Source: Texas Clean Rivers Program FY94-95 Program Guidance

The conventional parameters are defined in the existing Texas Surface Water Quality Standards (TSWQS) for each segment. The screening criteria were set as a fraction of the levels in the TSWQS, but do reflect differences between basins and segments to the extent that such differences are reflected in the standards. The reader should be aware that the values in the TSWQS for Total Dissolved Solids (TDS), Chlorides and Sulfates were developed from earlier analyses of segment water quality data. The values in the standards are not necessarily required to support a particular water use and are essentially empirical in nature. As water quality segments are frequently not homogeneous, data from a part of a segment that was not considered in the original standard setting analysis may exceed the value in the standards and/or the screening criteria. This does not necessarily constitute a water quality concern or problem.

Nutrient screening criteria are a single set of values to be applied across the state. At this time there are no water quality standards for nutrients, reflecting the different roles played by nutrients in different systems. Nutrients, primarily nitrogen and phosphorus, have the potential to limit aquatic plant growth if they are in low concentrations. This is the situation in many lakes and, a much more extreme example, the open ocean. Other minerals, notably silica and many trace metals also can be potentially limiting to plant growth in low concentrations. On the other hand, if there is an ample supply of nutrients, an excess level of plant growth can occur if that plant growth is not limited by some other factor such as light availability. In some cases a higher level of plant growth can be perceived as a water quality concern or problem, affecting aesthetic conditions, causing large daily dissolved oxygen fluctuations, and altering the aquatic community.

The difficulty with statewide screening criteria is that concentrations of major nutrients can be radically different in different systems, without there being significant differences in plant growth or water quality. For example, nutrient concentrations are typically over ten times higher than the screening criteria in effluent dominated streams, but because of turbidity or strong shade the stream may exhibit no excessive plant growth or other indication of quality problems. In other cases, nutrient concentrations much lower than the screening criteria could well be the cause of water quality concerns. Nutrient concentration alone is not sufficient to indicate anything definitive about the level of plant growth or water quality. Rather, the concentration must be considered in the context of a particular system. However, the level of complexity required for such a consideration is too great for a uniform statewide analysis. The screening criteria developed for this assessment are mid-range values that serve to focus attention on nutrients. However, an exceedance of these levels does not in itself constitute an actual water quality concern, nor does having lower concentrations than the criteria mean there is no concern.

There is also a screening criteria problem with trace metals which exist naturally and in most cases are essential micronutrients. However, the major difficulty with trace metals is not that they exist in very high concentrations but that they are very difficult to measure accurately[1] at near background concentrations. Essentially all of the existing metals data available for analysis were obtained using methods that the TNRCC and USGS now know are not appropriate for quantification at low and sub part per billion concentrations. The historical data have been retained because they may have some use in identifying a major and persistent anomaly and because it is never appropriate to destroy data, but they should not be considered reliable at low levels. Combining this difficulty with a set of standards that are in several cases close to background levels and it becomes very likely to have at least one value in the database for a segment which exceeds the screening criteria. While the existence of even one such detection in the database is termed a "concern" in this very conservative screening process, and certainly should be checked, the reader should recognize that data problems are the root cause of almost all screening criteria exceedances for metals.

Although a Screening Program in Paradox was provided by TNRCC to conduct a major part of the analysis, some data manipulation was also needed prior to the execution of the program. In some cases it was necessary to modify the parameter codes of data files or otherwise manipulate the data to meet the data analysis requirements. In all cases, the original data files were maintained. The following is a detailed step by step description of how the Step 2 data analysis was conducted for the Guadalupe River Basin:

a. Since only surface temperature measurements in °C are to be used in the analysis, all temperature data in °F (Parameter Code 00011) were first retrieved from the database. These data were converted to °C and reassigned a parameter code of 00010 before restoring to the database. Duplicates and data with depth greater than one-foot were eliminated to be sure that only surface temperature measurements remained. Original data files were retained.

[1]For example, the USGS Office of Water Quality, recognized the difficulty in a 1991 communication that was to be included in all data reports. In effect, the communication said that present USGS data above the microgram per liter level should be viewed with caution, and that actual levels without contamination problems may be substantially lower. EPA (1994, Method 1669) provides guidance on sampling and analysis procedures that are now required to achieve reliable results at typical ambient trace metal concentrations.

b. The pH data are stored under two codes: 00400 (field) and 00403 (lab). Although the Guidance states that only pH measurements taken in the field are to be evaluated, the handout of the Data Analysis Workshop run by the TNRCC also states that if there is no value for 00400 but there is a value for 00403 then the analyst is to use 00403 (The Workshop Handout actually calls 00400 lab data and 00403 field data). Therefore, following the procedures given in the Workshop, all lab pH data without a corresponding field data were retrieved from the database, reassigned a code of 00400, and restored to the database. The original data files without alteration were retained.

c. For TDS/conductivity data, the Paradox Program provided by TNRCC would automatically convert field conductivity data (code 00094) to TDS (code 70301) using a multiplier of 0.59 if there were no TDS value for that station-date. A review of the data showed that for Basin 18, there were no data stored under code 70301 but a total of 365 observations stored under 70300 (total filterable residual). Also, in addition to the 4,000 values stored under code 00094, there were a total of 1,400 values stored under code 00095 (lab conductivity). To insure that the best data were employed, the following steps were required. First, where there were no 70301 data but there were 70300 data, the 70300 values were converted to 70301. This insures that a directly measured TDS value would be employed over an estimate based on conductivity. Next, if there was no field conductivity (00094), but there was a lab value (00095), the laboratory value was reassigned to the field code before the Paradox Program was executed. This was done following Data Analysis Workshop instructions that laboratory data were preferred over no data, but field data were preferred over laboratory data. The Paradox program then takes the direct TDS measurement first, and uses the best available conductivity data where necessary. As with all work, the original data files were retained.

d. For DO, only surface values are to be analyzed. Therefore, DO data with depth greater than one-foot were eliminated from the database.

e. For Fecal Coliform bacteria (FC), only data within one-foot of the water's surface were evaluated.

f. Most of the stations in the basin lie on segments as defined by the TNRCC. The major exception is the area monitored by the UGRA, which contains a number of stations on tributaries to the Guadalupe River which are not TNRCC-designated segments. This same area also has a number of tributaries which are designated segments. As most of the tributaries are quite similar to the main stem and other tributary segments, these stations were assigned a flag indicating that they were on the main stem or the closest tributary segment. Exceptions to this procedure were made for three stations located on Third Creek, which receives the City of Kerrville wastewater discharge. These stations are 12563, 12564, and 12565. These were considered to be separate entities for the Step 2 analysis. In addition, the TNRCC and USGS data provided by TNRCC included a number of other stations not associated with segments. These were considered separately.

The Paradox Program provided by TNRCC was first executed to create 17_Value and 18_Value files for Basins 17 (Coastal) and 18 (River), respectively. The basins and their segments are shown in Figure D1-1. The Program was then executed for the Step 2 data analysis. This process also converted conductivity data to TDS. The output is two Paradox files, 17_STEP2 and 18_STEP2, with a blank column termed Conclusion.

Following the instructions given in the Guidance, the Conclusion columns of 17_STEP2 and 18_STEP2 were filled in parameter by parameter with either ID, NC, PC or C. The two completed files are included in a diskette provided to the TNRCC. Tables D2-2 summarize all segments and parameters with either PC or C in the Conclusion column for Basins 17 and 18.

Table D2-2 lists 4 parameters for basin 17, and a large number of parameters in Basin 18. These PC and C results fall into several categories. Some are common to nearly all segments while others are unique to a few segments. The following paragraphs discuss PC or C values that result from data screening problems and which can readily be eliminated from further discussion.

Phosphorus was shown by the TNRCC program to exceed criteria for four parameters in many segments. These exceedances result from two situations, both a consequence of the screening criteria. The first two are total and ortho phosphate, both reported as PO_4 rather than as P. Values reported as PO_4 are a substantial portion of the database and are higher by a factor of 2.8 than those reported as P. However, the screening criteria specified by the TNRCC, which appears to have been intended for use with data expressed as P, is the same for values expressed as PO_4. Almost all values

TABLE D2-2
SUMMARY OF STEP 2 DATA ANALYSIS RESULTS WITH C AND PC

Storet Code	Description of Parameters	Seg. id	No. of Data	No. Screened	Mean	15th%	Median	85th%	Std Dev	Max	Min	IQR	Criteria	Exceed Human Health	No. Exceeding Criteria	Percent Exceeding Criteria	MAL	No. Exceeding MAL	Percent Exceeding MAL	Conclusions
Basin 17																				
00610	NITROGEN, AMMONIA, TOTAL (MG/L AS N)	1701	46	46	0.381	0.025	0.085	0.38	1.464	10.11	0.005	0.182	0.15		16	34.8	0	16	34.8	PC
00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	1701	44	44	0.175	0.015	0.102	0.398	0.178	0.72	0.005	0.296	0.4		6	13.6	0	6	13.6	PC
00650	PHOSPHATE, TOTAL (MG/L AS PO4)	1701	16	16	0.468	0.305	0.445	0.625	0.156	0.77	0.21	0.24	0.4		9	56.3		9	56.3	C
00660	PHOSPHATE, ORTHO (MG/L AS PO4)	1701	16	16	0.173	0.027	0.06	0.44	0.207	0.73	0.015	0.241	0.2		4	25.0		4	25.0	PC
Basin 18																				
00010	TEMPERATURE, WATER (DEGREES CENTIGRADE)	12568	15	15	26.97	16	28.3	34.03	6.923	36	13.5	11.02	33.889		4	26.7		4	26.7	C
00300	OXYGEN, DISSOLVED (MG/L)	1810	110	110	6.135	4.8	5.85	7.307	1.64	13	1.2	1.6	5		25	22.7	0	25	22.7	PC
00300	OXYGEN, DISSOLVED (MG/L)	12540	48	48	7.142	5.278	6.805	9.335	1.703	10.81	4.74	2.428	6		15	31.3	0	15	31.3	C
00300	OXYGEN, DISSOLVED (MG/L)	12564	47	47	7.892	5.648	7.7	9.9	2.095	12.8	3	3.052	6		8	17.0	0	8	17.0	PC
00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	1801	102	102	1.662	0.995	1.6	2.295	0.788	4.2	0.005	0.712	0.4		97	95.1	0	97	95.1	C
00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	1803	263	263	1.701	0.559	1.2	2.6	1.823	16.9	0.015	1.345	1		162	61.6	0	162	61.6	C
00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	1804	166	166	1.118	0.595	1	1.497	0.739	6	0.01	0.571	1		82	49.4	0	82	49.4	PC
00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	1806	2,939	2,939	0.907	0.3	0.6	1.3	1.419	18.3	0	0.6	1		672	22.9	0	672	22.9	PC
00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	1808	161	161	1.236	0.732	1.1	1.538	0.883	8.51	0.18	0.502	1		94	58.4	0	94	58.4	C
00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	1810	52	52	2.683	0.518	2.15	5.537	2.225	7.99	0.08	3.405	1		35	67.3	0	35	67.3	C
00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	1811	58	58	1.625	1.383	1.645	1.8	0.353	2.7	0.224	0.261	1		56	96.6	0	56	96.6	C
00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	1814	23	23	1.221	1.034	1.17	1.335	0.301	2.46	0.78	0.178	1		20	87.0	0	20	87.0	C
00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	1816	184	184	2.221	0.4	0.9	1.9	14.58	199	0.07	0.882	1		73	39.7	0	73	39.7	PC
00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	1817	136	136	1.479	0.4	0.82	1.968	2.496	23	0.1	0.9	1		57	41.9	0	57	41.9	PC
00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	1818	185	185	1.113	0.3	0.5	1	3.424	33	0.03	0.4	1		26	14.1	0	26	14.1	PC
00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	12563	66	66	4.552	0.733	1.9	12.7	4.837	14.6	0.13	5.6	1		47	71.2	0	47	71.2	C
00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	12564	49	49	12.72	6.114	14.2	17.94	5.155	19.7	0.05	7.8	1		48	98.0	0	48	98.0	C
00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	12565	60	60	4.729	1.3	2.2	7.657	7.029	30.7	0.6	2.229	1		54	90.0	0	54	90.0	C
00625	NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)	1801	85	85	0.915	0.484	0.7	1.2	0.755	6.5	0.3	0.409	0		85	100.0		85	100.0	C
00625	NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)	1804	64	64	0.661	0.3	0.5	1.097	0.495	2.9	0.1	0.428	1		10	15.6		10	15.6	PC
00625	NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)	1808	9	9	0.548	0.263	0.34	0.954	0.331	1.18	0.13	0.527	1		1	11.1		1	11.1	PC
00625	NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)	1810	21	21	0.78	0.6	0.7	1.101	0.282	1.6	0.27	0.2	1		4	19.0		4	19.0	PC
00630	NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	1801	75	75	1.559	1.064	1.59	2	0.552	3.21	0.015	0.572	0.4		73	97.3		73	97.3	C
00630	NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	1803	77	77	1.973	0.998	1.8	3.202	1.058	5.1	0.3	1.2	1		63	81.8		63	81.8	C
00630	NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	1804	65	65	0.857	0.6	0.876	1.2	0.314	1.5	0.05	0.409	1		17	26.2		17	26.2	PC
00630	NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	1806	25	25	0.597	0.304	0.43	1.064	0.371	1.5	0.1	0.521	1		4	16.0		4	16.0	PC
00650	PHOSPHATE, TOTAL (MG/L AS PO4)	1801	50	50	2.128	1.408	1.93	2.787	0.849	5.2	0.86	0.833	0.4		50	100.0		50	100.0	C
00650	PHOSPHATE, TOTAL (MG/L AS PO4)	1803	34	34	0.954	0.334	0.8	1.598	0.814	4.3	0.15	0.793	0.2		32	94.1		32	94.1	C
00650	PHOSPHATE, TOTAL (MG/L AS PO4)	1804	23	23	0.32	0.18	0.28	0.462	0.175	0.8	0.15	0.144	0.2		17	73.9		17	73.9	C
00650	PHOSPHATE, TOTAL (MG/L AS PO4)	1805	15	15	0.457	0.015	0.03	1.357	0.963	2.88	0.015	0.141	0.2		3	20.0		3	20.0	PC
00650	PHOSPHATE, TOTAL (MG/L AS PO4)	1807	15	15	0.129	0.09	0.12	0.169	0.051	0.28	0.06	0.024	0.2		2	13.3		2	13.3	PC
00650	PHOSPHATE, TOTAL (MG/L AS PO4)	1808	16	16	0.576	0.306	0.535	0.891	0.249	1.04	0.248	0.399	0.2		16	100.0		16	100.0	C
00650	PHOSPHATE, TOTAL (MG/L AS PO4)	1809	28	28	0.173	0.015	0.06	0.49	0.208	0.58	0.015	0.415	0.2		8	28.6		8	28.6	PC
00650	PHOSPHATE, TOTAL (MG/L AS PO4)	1810	24	24	2.698	1.212	2.2	4.348	1.455	6.55	0.92	2.389	0.2		24	100.0		24	100.0	C
00650	PHOSPHATE, TOTAL (MG/L AS PO4)	1811	16	16	0.129	0.015	0.032	0.355	0.23	0.89	0.015	0.045	0.2		3	18.8		3	18.8	PC
00650	PHOSPHATE, TOTAL (MG/L AS PO4)	1812	15	15	0.099	0.03	0.09	0.19	0.067	0.21	0.015	0.12	0.2		2	13.3		2	13.3	PC
00650	PHOSPHATE, TOTAL (MG/L AS PO4)	12563	68	68	0.187	0.05	0.101	0.329	0.197	0.812	0.03	0.148	0.2		23	33.8		23	33.8	PC

TABLE D2-2 (Continued)
SUMMARY OF STEP 2 DATA ANALYSIS RESULTS WITH C AND PC

Storet Code	Description of Parameters	Seg. id	No. of Data	No. Screened	Mean	15th%	Median	85th%	Std Dev	Max	Min	IQR	Criteria	Exceed Human Health	No. Exceeding Criteria	Percent Exceeding Criteria	MAL	No. Exceeding MAL	Percent Exceeding MAL	Conclusions
00650	PHOSPHATE, TOTAL (MG/L AS PO4)	12564	52	52	0.564	0.312	0.5125	0.795	0.318	2.274	0.026	0.286	0.2		48	92.3		48	92.3	C
00650	PHOSPHATE, TOTAL (MG/L AS PO4)	12565	56	56	0.324	0	0.2625	0.492	0.434	2.1	0	0.401	0.2		31	55.4		31	55.4	C
00650	PHOSPHATE, TOTAL (MG/L AS PO4)	12568	9	9	0.689	0.17	0.7	1.228	0.48	1.68	0.03	0.701	0.2		8	88.9		8	88.9	C
00660	PHOSPHATE, ORTHO (MG/L AS PO4)	1801	50	50	1.634	0.826	1.62	2.39	0.786	4.6	0.64	1.13	0.2		50	100.0		50	100.0	C
00660	PHOSPHATE, ORTHO (MG/L AS PO4)	1803	42	42	0.426	0.112	0.37	0.743	0.336	1.5	0.03	0.454	0.2		29	69.0		29	69.0	C
00660	PHOSPHATE, ORTHO (MG/L AS PO4)	1804	21	21	0.162	0.015	0.15	0.257	0.157	0.73	0.015	0.185	0.2		8	38.1		8	38.1	PC
00660	PHOSPHATE, ORTHO (MG/L AS PO4)	1808	16	16	0.401	0.23	0.355	0.625	0.212	0.89	0.015	0.293	0.2		14	87.5		14	87.5	C
00660	PHOSPHATE, ORTHO (MG/L AS PO4)	1809	27	27	0.115	0.015	0.015	0.386	0.165	0.46	0.015	0.275	0.2		7	25.9		7	25.9	PC
00660	PHOSPHATE, ORTHO (MG/L AS PO4)	1810	24	24	2.152	0.668	1.545	4.097	1.62	6.52	0.015	2.247	0.2		22	91.7		22	91.7	C
00660	PHOSPHATE, ORTHO (MG/L AS PO4)	12565	12	12	0.348	0.262	0.345	0.446	0.077	0.48	0.24	0.121	0.2		12	100.0		12	100.0	C
00660	PHOSPHATE, ORTHO (MG/L AS PO4)	12568	9	9	0.395	0.027	0.49	0.647	0.234	0.67	0.015	0.421	0.2		7	77.8		7	77.8	C
00665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	1801	103	103	0.747	0.43	0.6	0.912	0.797	8.22	0.28	0.298	0.4		94	91.3		94	91.3	C
00665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	1803	380	380	0.496	0.1	0.35	0.936	0.526	4.32	0.02	0.54	0.2		246	64.7		246	64.7	C
00665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	1808	163	163	0.157	0.069	0.12	0.24	0.156	1.38	0.005	0.11	0.2		34	20.9		34	20.9	PC
00665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	1810	54	54	0.803	0.346	0.565	1.434	0.531	2.14	0.17	0.844	0.2		53	98.1		53	98.1	C
00665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	12568	11	11	0.201	0.071	0.19	0.354	0.151	0.55	0.01	0.196	0.2		5	45.5		5	45.5	PC
00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L A	1801	101	101	0.584	0.276	0.47	0.757	0.781	7.93	0.005	0.339	0.2		99	98.0		99	98.0	C
00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L A	1803	148	148	0.137	0.04	0.1025	0.271	0.112	0.49	0.005	0.161	0.2		38	25.7		38	25.7	PC
00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L A	1808	52	52	0.117	0.034	0.095	0.188	0.098	0.62	0.005	0.09	0.2		6	11.5		6	11.5	PC
00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L A	1810	54	54	0.647	0.234	0.48	1.324	0.504	2.13	0.005	0.6	0.2		48	88.9		48	88.9	C
00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L A	12563	15	15	0.059	0.013	0.023	0.139	0.09	0.294	0.012	0.018	0.2		2	13.3		2	13.3	PC
00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L A	12568	11	11	0.109	0.01	0.15	0.208	0.081	0.22	0.005	0.162	0.2		2	18.2		2	18.2	PC
00940	CHLORIDE (MG/L AS CL)	1801	103	103	70.98	44	71	93.12	27.02	158	14	36.8			103	100.0	0	103	100.0	PC
00940	CHLORIDE (MG/L AS CL)	1806	2,087	2,087	27.21	14	21	31	42.31	570	5	10	35		211	10.1	0	211	10.1	PC
00940	CHLORIDE (MG/L AS CL)	1814	23	23	22.04	12	18	21.84	20.71	117	12	4.6	25		3	13.0	0	3	13.0	PC
00940	CHLORIDE (MG/L AS CL)	1816	147	147	57.56	21	26	38.52	98.66	430	0.5	10.8	40		20	13.6	0	20	13.6	PC
00940	CHLORIDE (MG/L AS CL)	1817	128	128	47.71	9	12	17	112.3	416	4	3.978	20		14	10.9	0	14	10.9	PC
00940	CHLORIDE (MG/L AS CL)	12563	41	41	64.15	28	46	115.3	43.49	203	16	53.5	35		30	73.2	0	30	73.2	PC
00940	CHLORIDE (MG/L AS CL)	12564	37	37	156.9	97.86	167	204	50.89	247	16	67.9	35		36	97.3	0	36	97.3	PC
00940	CHLORIDE (MG/L AS CL)	12565	26	26	149.3	77.33	152.5	192.7	73.5	422	20	71.2	35		25	96.2	0	25	96.2	PC
00940	CHLORIDE (MG/L AS CL)	13657	83	83	214.1	110	210	270	105.7	600	14	120	100		72	86.7	0	72	86.7	PC
00945	SULFATE (MG/L AS SO4)	1801	103	103	52.97	36.88	52	64.12	22.45	230	11	16.8			103	100.0	0	103	100.0	PC
00945	SULFATE (MG/L AS SO4)	1806	2,376	2,376	18.55	9	16	29	11.89	195	0	12	30		302	12.7	0	302	12.7	PC
00945	SULFATE (MG/L AS SO4)	1814	24	24	21.58	6.21	24.5	29	8.93	32	3	11.3	25		11	45.8	0	11	45.8	PC
00945	SULFATE (MG/L AS SO4)	12563	64	64	42.95	18	27	56.85	59.04	472	4	28.55	30		31	48.4	0	31	48.4	PC
00945	SULFATE (MG/L AS SO4)	12564	48	48	72	57	72.5	84.48	13.55	103	42	14	30		48	100 0	0	48	100.0	PC
00945	SULFATE (MG/L AS SO4)	12565	22	22	48.18	33	51	62	13.11	70	23	21.68	30		21	95.5	0	21	95.5	PC
00945	SULFATE (MG/L AS SO4)	12576	9	9	70.67	59.56	74	78.88	7.958	82	58	13.1	50		9	100.0	0	9	100.0	PC
00945	SULFATE (MG/L AS SO4)	13657	83	83	61.2	27	54	101.2	35.4	150	0.5	60.2	50		42	50.6	0	42	50.6	PC
01000	ARSENIC, DISSOLVED (UG/L AS AS)	1803	63	63	3.071	1	2	3.12	6.067	50	0.5	1	37.5		1	1.6	10	1	1.6	C
01005	BARIUM, DISSOLVED (UG/L AS BA)	1801	1	1	70	29.4	70	40.6	0	70	70	28	0		1	100.0	100	0	0.0	C
01007	BARIUM, TOTAL (UG/L AS BA)	1801	9	9	134.3	84.84	100	213.2	59.31	260	63	77.5	0		9	100.0	100	4	44.4	C

TABLE D2-2 (Concluded)
SUMMARY OF STEP 2 DATA ANALYSIS RESULTS WITH C AND PC

Storet Code	Description of Parameters	Seg. id	No. of Data	No. Screened	Mean	15th%	Median	85th%	Std Dev	Max	Min	IQR	Criteria	Exceed Human Health	No. Exceeding Criteria	Percent Exceeding Criteria	MAL	No. Exceeding MAL	Percent Exceeding MAL	Conclusions
01025	CADMIUM, DISSOLVED (UG/L AS CD)	1803	63	62	0.661	0.5	0.5	.1	0.429	3	0.5	0	1.1696		3	4.8	1	3	4.8	C
01025	CADMIUM, DISSOLVED (UG/L AS CD)	1813	14	14	0.714	0.5	0.5	1.205	0.525	2	0.5	0	1.1696		2	14.3	1	2	14.3	C
01027	CADMIUM, TOTAL (UG/L AS CD)	1804	20	2	3.2	4.028	3.2	5	1.8	5	1.4	-0.07	1.1696		2	100.0	1	2	100.0	C
01040	COPPER, DISSOLVED (UG/L AS CU)	1803	63	63	2.611	0.94	2	5	2.445	15	0.5	3	13.571		1	1.6	10	1	1.6	C
01042	COPPER, TOTAL (UG/L AS CU)	1801	11	7	11.81	1.892	12	21	7.659	21	0.5	15.92	3.2775		6	85.7	10	4	57.1	C
01042	COPPER, TOTAL (UG/L AS CU)	1804	20	4	262.1	1.06	3.75	1009	449.1	1040	1	572.1	13.571		1	25.0	10	1	25.0	C
01049	LEAD, DISSOLVED (UG/L AS PB)	1803	63	36	1.958	0.5	0.5	5	2.436	10	0.5	2.05	3.75		8	22.2	10	0	0.0	C
01049	LEAD, DISSOLVED (UG/L AS PB)	1812	18	5	4.7	0.59	2	10	4.354	10	0.5	9.15	3.75		2	40.0	10	0	0.0	C
01049	LEAD, DISSOLVED (UG/L AS PB)	1813	14	2	10.25	14.74	10.25	20	9.75	20	0.5	-0.03	3.75		1	50.0	10	1	50.0	C
01051	LEAD, TOTAL (UG/L AS PB)	1801	11	2	8.2	10.87	8.2	14	5.8	14	2.4	-0.12	2.8875		1	50.0	10	1	50.0	C
01051	LEAD, TOTAL (UG/L AS PB)	1803	4	4	16.75	8.12	13	32.43	9.627	33	8	14.65	3.75		4	100.0	10	3	75.0	C
01075	SILVER, DISSOLVED (UG/L AS AG)	1803	75	3	1	1	1	1	0	1	1	0	0.3675		3	100.0	2	0	0.0	C
01075	SILVER, DISSOLVED (UG/L AS AG)	1806	20	2	1	1.46	1	2	1	2	0	-0	0.3675		1	50.0	2	0	0.0	C
01075	SILVER, DISSOLVED (UG/L AS AG)	1812	18	1	1	0.42	1	0.58	0	1	1	0.4	0.3675		1	100.0	2	0	0.0	C
01075	SILVER, DISSOLVED (UG/L AS AG)	1813	14	2	1	1	1	1	0	1	1	-0.05	0.3675		2	100.0	2	0	0.0	C
01090	ZINC, DISSOLVED (UG/L AS ZN)	1801	3	3	37.67	27.6	30	73	26.28	73	10	50.4	66.75		1	33.3	5	1	33.3	C
01092	ZINC, TOTAL (UG/L AS ZN)	1801	10	10	47.3	10	26	78.86	46.16	170	10	48.7	66.75		3	30.0	5	3	30.0	C
01105	ALUMINUM, TOTAL (UG/L AS AL)	1801	1	1	4780	2008	4780	2772	0	4780	4780	1912	0		1	100.0	100	1	100.0	C
31616	FECAL COLIFORM,MEMBR FILTER,M-FC BROTH, #/100ML	1801	38	38	290.7	5	84.5	398.1	721.1	4266	5	176.6	400		5	13.2	0	5	13.2	PC
31616	FECAL COLIFORM,MEMBR FILTER,M-FC BROTH, #/100ML	1803	228	228	693.7	20	112	748.5	2532	32600	3.5	328.5	400		53	23.2	0	53	23.2	PC
31616	FECAL COLIFORM,MEMBR FILTER,M-FC BROTH, #/100ML	1804	159	159	400.7	25	80	372.5	1926	22600	0.5	173.4	400		22	13.8	0	22	13.8	PC
31616	FECAL COLIFORM,MEMBR FILTER,M-FC BROTH, #/100ML	1806	3,832	3,832	255.5	9	52	324	963.9	37620	0	153.1	400		464	12.1	0	464	12.1	PC
31616	FECAL COLIFORM,MEMBR FILTER,M-FC BROTH, #/100ML	1808	167	167	928.8	24	67	425.6	5523	67000	0	126.4	400		26	15.6	0	26	15.6	PC
31616	FECAL COLIFORM,MEMBR FILTER,M-FC BROTH, #/100ML	1810	34	34	526.5	55.53	160	479.4	1292	6800	16	248.6	400		6	17.6	0	6	17.6	PC
31616	FECAL COLIFORM,MEMBR FILTER,M-FC BROTH, #/100ML	12560	10	10	137.1	14.92	70	201.3	230.6	816	0.5	86.75	400		1	10.0	0	1	10 0	PC
31616	FECAL COLIFORM,MEMBR FILTER,M-FC BROTH, #/100ML	12563	56	56	277.7	20	80	182.4	1161	8800	0.5	96.5	400		7	12.5	0	7	12.5	PC
31616	FECAL COLIFORM,MEMBR FILTER,M-FC BROTH, #/100ML	12564	48	48	412.1	56.82	198	671.1	643.6	2977	2	324	400		11	22.9	0	11	22.9	PC
31616	FECAL COLIFORM,MEMBR FILTER,M-FC BROTH, #/100ML	12565	87	87	433.4	88	164	520.4	752.7	3600	26	206.4	400		19	21.8	0	19	21.8	PC
31616	FECAL COLIFORM,MEMBR FILTER,M-FC BROTH, #/100ML	12568	14	14	211.4	7.65	82.5	443.5	307.4	1180	5	286.5	400		3	21.4	0	3	21.4	PC
39516	PCBS IN WHOLE WATER SAMPLE (UG/L)	1803	11	1	0.1	0.042	0.1	0.058	0	0.1	0.1	0.04	0		1	100.0	0.7	0	0.0	C
70301	SOLIDS, DISSOLVED-SUM OF CONSTITUENTS (MG/L)	1801	162	162	424.8	304.6	430	516	112.7	1092	210.6	132.9			162	100.0	0	162	100.0	PC
70301	SOLIDS, DISSOLVED-SUM OF CONSTITUENTS (MG/L)	1803	530	530	350.6	270	345	443.1	85.04	732.2	4.968	105.1	400		141	26.6	0	141	26.6	PC
70301	SOLIDS, DISSOLVED-SUM OF CONSTITUENTS (MG/L)	1807	144	144	323.2	185.3	278.78	519.7	146.1	788.8	100.3	187.9	500		25	17.4	0	25	17.4	PC
70301	SOLIDS, DISSOLVED-SUM OF CONSTITUENTS (MG/L)	12563	74	74	400.3	290.4	361.38	526.2	121.2	744.6	236.6	175.7	375		34	45.9	0	34	45.9	PC
70301	SOLIDS, DISSOLVED-SUM OF CONSTITUENTS (MG/L)	12564	48	48	637.2	525.1	656.08	718.9	99.58	1021	456	126.1	375		48	100.0	0	48	100.0	PC
70301	SOLIDS, DISSOLVED-SUM OF CONSTITUENTS (MG/L)	12565	57	57	699.2	457.3	590	726.2	802.8	6649	362.3	160.5	375		56	98.2	0	56	98.2	PC
70301	SOLIDS, DISSOLVED-SUM OF CONSTITUENTS (MG/L)	12568	23	23	670.3	596.4	688	817	172.8	826	180	170.9	500		21	91.3	0	21	91.3	PC
70301	SOLIDS, DISSOLVED-SUM OF CONSTITUENTS (MG/L)	12576	65	65	513.4	506.8	511.53	521.3	18	569.9	460	9.204	400		65	100.0	0	65	100 0	PC
70301	SOLIDS, DISSOLVED-SUM OF CONSTITUENTS (MG/L)	13657	96	96	769.6	449.8	769.95	1010	296.3	1788	90.27	333	400		89	92.7	0	89	92.7	PC
70507	PHOSPHORUS,IN TOTAL ORTHOPHOSPHATE (MG/L AS P)	1803	22	22	0.38	0.047	0.275	0.727	0.374	1.4	0.01	0.492	0.2		13	59.1		13	59.1	C
71890	MERCURY DISSOLVED, IN WATER (UG/L)	1803	63	63	0.095	0.05	0.05	0.1	0.174	1.4	0.05	0.05	0.975		1	1.6	2	0	0 0	C
71900	MERCURY, TOTAL (UG/L AS HG)	1801	11	7	0.771	0.1	0.1	2.44	1.161	3.4	0.1	1.06	0.825		2	28 6	2	1	14.3	C
71900	MERCURY, TOTAL (UG/L AS HG)	1804	20	20	0.342	0.1	0.17	0.314	0.753	3.6	0.1	0.1	0.975		1	5.0	2	1	5 0	C

in the database expressed as PO_4 exceed the screening level set to be expressed as P. Since the problem can't be corrected without major effort and there is no shortage of phosphorus data, the PO_4 data were dropped from further analysis.

The other problem with the P screening criteria is the values themselves. They were selected in a very conservative manner. Most of the segments in the lower basin exceed these criteria. However, possibly because of natural high turbidity which limits light penetration, there are no reports of excessive plant growth problems. The only segments where such values would be considered a concern are those in the Hill Country. However, with the exception of stations on Third Creek receiving Kerrville wastewater, none of the Hill Country segments exhibit concerns.

Nitrate-N (00620) and Nitrate+Nitrite-N (00630) also showed a very high percentage of screening criteria exceedance. Again, the problem is the selection of screening criteria of 0.4 mg/L for estuarine segments and 1.0 mg/L for riverine segments. These criteria might be appropriate for identifying a concern in a lake or estuary but not a basin that is predominantly a river system. The Guadalupe River is fed by springs from the Edwards Aquifer which typically have Nitrate-N levels of 1-2 mg/L, and also receives agricultural return flows and some wastewater discharges. The typical nitrate-N concentration in the basin is much higher than the screening criteria but no cause for water quality concern. In the upper basin, the main reason is that phosphorus tends to be limiting while in the lower basin, light tends to limit plant growth due to relatively high turbidity produced with the coastal plain soils.

There are also a number of "C" values showing up for metals. These are ultimately found in Step 5/6 to be data or screening criteria problems, rather than water quality problems. As noted earlier, effectively none of the data were collected and analyzed with the clean methods now considered essential for reliable results. However, to follow the Guidance, all metal screening results are retained for later steps.

Another parameter showing a number of "Cs" in the Step 2 analysis is FC bacteria. In this case, many of the segments had more than 10% of their data exceeding the 400 colony forming unit (cfu)/100 mL screening criterion, along with all three stations on Third Creek. FC levels in surface waters are strongly controlled by recent runoff from the land. Since the frequency of sampling events following some amount of rain in a watershed is both variable year-to-year (e.g., wet year and dry year differences are substantial, and scheduling patterns are essentially random even with the same precipitation frequency), the percentage of observations having relatively high FC levels will vary substantially. Typically, the percentage is in the range of 10 to 20%. The data for this basin look quite normal. While there appear to be no real concerns indicated with the step 2 review, the FC data are retained for further step analysis.

The final point of elimination was the data from the three stations on Third Creek in the UGRA area. These stations were kept separate from the segment because they are substantially different from the other stations as a result of their being directly influenced by a wastewater discharge. They will be dealt with in a separate manner so as to not burden the reader with obvious differences.

Step 3 - Secondary Evaluation

The objective of Step 3 data analysis is to eliminate gross errors and to determine whether data sets from various agencies are similar. In the 1992 and 1994 assessment reports comparisons of agency data were performed and it was found that data from each monitoring agency were very similar. This comparison was not repeated for this assessment. A search through the database was also conducted to pick up obvious outliers. The search included: temperature greater than 40°C, DO greater than 16 mg/L, pH greater than 14 and all negative values. A total of 24 values meeting these criteria were found and first checked to be sure that there was no data transfer errors and then removed from the database before Step 4 was conducted.

Step 4 - Secondary Screening

The Step 4 analysis is very similar to Step 2 except for several parameters that require additional manipulation before executing the Step 4 Paradox program. The following is a detailed description of how the Step 4 analysis was conducted:

Conductivity-TDS

The Guidance calls for the development of an appropriate ratio for TDS-to-conductivity for each segment. To do this, all paired data, i.e., with both TDS and conductivity measurements on the same event dates, were first retrieved from the database. As summarized in Table D4-1, a TDS-to-conductivity ratio was computed for each pair of data and an average ratio was determined for each segment. An overall ratio was determined to be 0.58, which is very close to the 0.59 value used in Step 2 analysis. Conductivity data without paired TDS values were then converted to TDS segment by

TABLE D4-1
RATIO OF TDS AND CONDUCTIVITY FOR BASIN 18

Segment	Number of Paired TDS - Conductivity Data	Average Ratio of TDS / Conductivity
1801	54	0.56
1803	106	0.58
1804	54	0.58
1805	19	0.53
1806	87	0.59
1807	11	0.60
1808	30	0.59
1809	61	0.57
1810	90	0.60
1811	42	0.51
1812	20	0.57
1813	35	0.61
1814	3	0.63
1815	16	0.61
1816	3	0.66
1817	2	0.53
1818	3	0.67
Average =	37	0.58

segment using the ratios listed in Table D4-1. These converted TDS data together with the rest of TDS data are stored in a separate database file, 18_VAL2, which is in the same format as the 18_VALUE file.

Annual Average Comparisons

The Step 2 analysis of TDS, chlorides and sulfates was based on the percentage (10%) of individual values exceeding the criteria specified for each segment. In reality, the Standards specify that determinations of standards attainment for these parameters is to be made based on the annual averages, rather than an arbitrary percentage of observations exceeding the criteria. The Step 4 analysis specifies the use of annual average data for comparisons. To accomplish this, both chloride and sulfate were retrieved from 18_VALUE and inserted into 18_VAL2. The Create Annual Average function of the Paradox Program provided by TNRCC was executed with 18_VAL2 selected. This process produced a file named 18ANNAVG, a table with the annual average concentrations for chlorides, sulfates and TDS for each segment and unclassified station.

The Step 4 Statistics of the Paradox Program were then executed three times for chlorides, sulfates and TDS using 18ANNAVG file. The output is a file named 18AAWORK, which is in the same format as the Step 2 output file but with the Conclusion column blank. The Conclusion column of 18AAWORK was filled in with either ID, NC, PC or C according to the instructions given in the Guidance. The new script file provided by TNRCC to conduct these annual average analyses is hardwired to use data only between 1990 and 1997, discarding all data before 1990. Therefore, the results listed in Table D4-2 represent conditions of recent years.

Table D4-2 summarizes the results in 18AAWORK, eliminating those parameter/segments with NC or ID (very few) designations. It can be seen that employing the annual average values, as intended in the Standards, greatly reduces the number of PC and C screening results. Where Table D2-2 had included 26 PC or C results for Cl, SO_4 and TDS, only 7 remain in Table D4-2. A possible reason why the numbers of PC & C drop from 26 to 7 is that the Step 2 script uses all data while the annual average script only uses 1990-1997 data. Furthermore, it must be emphasized that the Standards, which are the basis of the screening criteria, were developed from an earlier version of the same database, except that only the TNRCC's SMN database rather than the larger database is used here. Small differences in these parameters have no effect on water quality or uses. Unless the departure from the Standards was caused by an action of man and has some kind of adverse effect on quality or use, the difference may not be significant and only indicates a need to revise the Standards.

TABLE D4-2

SUMMARY OF ANNUAL AVERAGE DATA ANALYSIS RESULTS WITH C AND PC

Seg. id	Storet Code	Description of Parameters	No. of Data	No. Screened	Mean	15th%	Median	85th%	Std Dev	Max	Min	IQR	Criteria	Exceed Human Health	No. Exceeding Criteria	Percent Exceeding Criteria	MAL	No. Exceeding MAL	Percent Exceeding MAL	Conclusions
1812	00945	SULFATE (MG/L AS SO4)	6	6	23.92	6.916	19.5	52.29	20.32	67.5	5.2	13.57	40		1	16.7	0	1	16.7	PC
	00940	CHLORIDE (MG/L AS CL)	2	2	175.3	176	175.26	176.8	1.536	176.8	173.7	-8.69	35		2	100.0	0	2	100.0	C
12564[1]	00945	SULFATE (MG/L AS SO4)	2	2	73.98	74.82	73.977	75.8	1.823	75.8	72.15	-3.61	30		2	100.0	0	2	100.0	C
	70301	SOLIDS, DISSOLVED-SUM OF CONSTITUENTS (MG/L)	2	2	661	675.8	661.03	693.1	32.05	693.1	629	-31.4	375		2	100.0	0	2	100.0	C
	00940	CHLORIDE (MG/L AS CL)	5	5	211.7	164.9	214	267.5	39.32	278.3	159.8	56.64	100		5	100.0	0	5	100.0	C
13657[2]	00945	SULFATE (MG/L AS SO4)	6	6	51.41	16.96	45.65	96.56	31.97	110.3	12.75	45.82	50		3	50.0	0	3	50.0	C
	70301	SOLIDS, DISSOLVED-SUM OF CONSTITUENTS (MG/L)	5	5	754.7	587	768.29	952.3	141.6	985.4	574.4	233.2	400		5	100.0	0	5	100.0	C

[1] THIRD CREEK, 0.5 KM ABOVE CONFLUENCE WITH GUADALUPE RIVER

[2] SANDIES CREEK 100 FT. DOWNSTREAM OF COUNTY HIGHWAY, 1.9 MI. UPSTREAM FROM BIRDS CREEK, 2.0 MI. NE OF WESTHOFF

Dissolved Oxygen

The Guidance requires that surface DO data be separated into two subsets: one containing spring measurements only and the other containing measurements for the remainder of the year. However, as there were very few DO concerns, separation of DO data into spring and non-spring data sets to identify whether there is a real concern was neglected. Instead, all DO data are used in Step 4 data analysis.

FC Bacteria

The original Guidance document required that FC data be aggregated into three data sets: data measured at high flow, low flow and all flows. The major limitation is that for most locations, flow data are not available. In the 1994 assessment, an attempt was made to approximately the flows by using data from the nearest available location. This analysis produced little of value, while considering the "all flow" criteria was useful. For this analysis, only the "all flow" criterion of greater than 25% of the data exceeding 400 cfu/100 mL was employed.

Step 4 Results

The Step 4 Statistics package of the Paradox Program was executed for basins 17 and 18. Following the instructions given in the Guidance, the Conclusion column was filled in with either ID, NC, PC or C. Table D4-3 summarizes the results of Step 4 analysis for both basins 17 and 18. The Step 4 data analysis reduced the number of concerns generated in Step 2, but many still remain.

Step 5 and 6 Analysis of Possible Concerns

The Guidance Document includes two steps to gain insight into concerns, leading to identification of possible causes and measures that could be taken to address the concerns. As stated in the Guidance, the intent of these steps is to be flexible.

In the 1994 Assessment, part of the Step 5/6 analysis was reviewing PCs and Cs by segment and part of the analysis was an analysis and discussion of parameters which exhibited PC-C findings. The basic conclusion of this segment and parameter analysis was that essentially all of the PC-C findings were attributable to screening criteria or data problems and not indicative of actual water quality problems.

TABLE D4-3
SUMMARY OF STEP 4 DATA ANALYSIS RESULTS WITH C AND PC

Seg. id	Storet Code	Description of Parameters	No. of Data	No. Screened	Mean	15th%	Median	85th%	Std Dev	Max	Min	IQR	Criteria	Exceed Human Health	No. Exceeding Criteria	Percent Exceeding Criteria	MAL	No. Exceeding MAL	Percent Exceeding MAL	Conclusions
Basin 17																				
1701	00610	NITROGEN, AMMONIA, TOTAL (MG/L AS N)	46	46	0.381	0.025	0.085	0.38	1.464	10.11	0.005	0.182	0.15		16	34.8	0	16	34.8	PC
	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	44	44	0.175	0.015	0.102	0.398	0.178	0.72	0.005	0.296	0.4	N	6	13.6	0	6	13.6	PC
Basin 18																				
	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	102	102	1.662	0.995	1.6	2.295	0.788	4.2	0.005	0.712	0.4	N	97	95.1	0	97	95.1	C
	00630	NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	75	75	1.559	1.064	1.59	2	0.552	3.21	0.015	0.572	0.4		73	97.3		73	97.3	C
	00665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	103	103	0.747	0.43	0.6	0.912	0.797	8.22	0.28	0.298	0.4		94	91.3		94	91.3	C
1801	00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P)	101	101	0.584	0.276	0.47	0.757	0.781	7.93	0.005	0.339	0.2		99	98.0		99	98.0	C
	01042	COPPER, TOTAL (UG/L AS CU)	11	9	9.967	1.67	7.8	21	7.62	21	0.5	15.22	18.167		2	22.2	10	2	22.2	PC
	01051	LEAD, TOTAL (UG/L AS PB)	11	3	6.3	2.488	2.5	14	5.445	14	2.4	9.28	5.3631	Y	1	33.3	10	1	33.3	PC
	01092	ZINC, TOTAL (UG/L AS ZN)	10	10	47.3	10	26	78.86	46.16	170	10	48.7	150.04		1	10.0	5	1	10.0	PC
	71900	MERCURY, TOTAL (UG/L AS HG)	11	11	0.673	0.1	0.5	1.328	0.935	3.4	0.1	0.4	1.1	Y	2	18.2	2	1	9.1	PC
	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	263	263	1.701	0.559	1.2	2.6	1.823	16.9	0.015	1.345	1	N	162	61.6	0	162	61.6	C
	00625	NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)	126	126	0.743	0.3	0.7	1.1	0.424	2.2	0.1	0.6	1		28	22.2		28	22.2	PC
	00630	NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	77	77	1.973	0.998	1.8	3.202	1.058	5.1	0.3	1.2	1		63	81.8		63	81.8	C
	00665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	380	380	0.496	0.1	0.35	0.936	0.526	4.32	0.02	0.54	0.2		246	64.7		246	64.7	C
	00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P)	148	148	0.137	0.04	0.1025	0.271	0.112	0.49	0.005	0.161	0.2		38	25.7		38	25.7	PC
1803	01025	CADMIUM, DISSOLVED (UG/L AS CD)	63	62	0.661	0.5	0.5	1	0.429	3	0.5	0	2.165	N	1	1.6	1	1	1.6	PC
	01049	LEAD, DISSOLVED (UG/L AS PB)	63	53	2.132	0.5	2	3.62	2.024	10	0.5	2	9.0742	N	1	1.9	10	0	0.0	PC
	01051	LEAD, TOTAL (UG/L AS PB)	4	4	16.75	8.12	13	32.43	9.627	33	8	14.65	9.0742	Y	3	75.0	10	3	75.0	C
	01075	SILVER, DISSOLVED (UG/L AS AG)	75	3	1	1	1	1	0	1	1	0	0.49	N	3	100.0	2	0	0.0	PC
	39516	PCBS IN WHOLE WATER SAMPLE (UG/L)	11	1	0.1	0.042	0.1	0.058	0	0.1	0.1	0.04	0.014	Y	1	100.0	0.65	0	0.0	PC
	71890	MERCURY DISSOLVED, IN WATER (UG/L)	63	63	0.095	0.05	0.05	0.1	0.174	1.4	0.05	0.05	1.3	Y	1	1.6	2	0	0.0	PC
	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	166	166	1.118	0.595	1	1.497	0.739	6	0.01	0.571	1	N	82	49.4	0	82	49.4	PC
	00625	NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)	64	64	0.661	0.3	0.5	1.097	0.495	2.9	0.1	0.428	1		10	15.6		10	15.6	PC
1804	00630	NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	65	65	0.857	0.6	0.876	1.2	0.314	1.5	0.05	0.409	1		17	26.2		17	26.2	PC
	01027	CADMIUM, TOTAL (UG/L AS CD)	20	2	3.2	4.028	3.2	5	1.8	5	1.4	-0.07	1.9547	N	1	50.0	1	1	50.0	PC
	01042	COPPER, TOTAL (UG/L AS CU)	20	20	60.43	6.865	10	10	224.7	1040	1	0	23.137		1	5.0	10	1	5.0	PC
	71900	MERCURY, TOTAL (UG/L AS HG)	20	20	0.342	0.1	0.17	0.314	0.753	3.6	0.1	0.1	1.3	Y	1	5.0	2	1	5.0	PC
	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	2,939	2,939	0.907	0.3	0.6	1.3	1.419	18.3	0	0.6	1	N	672	22.9	0	672	22.9	PC
1806	00630	NITRITE PLUS NITRATE, TOTAL 1 DET. (MG/L AS N)	25	25	0.597	0.304	0.43	1.064	0.371	1.5	0.1	0.521	1		4	16.0		4	16.0	PC
	01075	SILVER, DISSOLVED (UG/L AS AG)	20	2	1	1.46	1	2	1	2	0	-0	0.49	N	1	50.0	2	0	0.0	PC

TABLE D4-3 (Concluded)
SUMMARY OF STEP 4 DATA ANALYSIS RESULTS WITH C AND PC

Seg. id	Storet Code	Description of Parameters	No. of Data	No. Screened	Mean	15th%	Median	85th%	Std Dev	Max	Min	IQR	Criteria	Exceed Human Health	No. Exceeding Criteria	Percent Exceeding Criteria	MAL	No. Exceeding MAL	Percent Exceeding MAL	Conclusions
1808	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	161	161	1.236	0.732	1.1	1.538	0.883	8.51	0.18	0.502	1	N	94	58.4	0	94	58.4	C
	00625	NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)	9	9	0.548	0.263	0.34	0.954	0.331	1.18	0.13	0.527	1		1	11.1		1	11.1	PC
	00665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	163	163	0.157	0.069	0.12	0.24	0.156	1.38	0.005	0.11	0.2		34	20.9		34	20.9	PC
	00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P)	52	52	0.117	0.034	0.095	0.188	0.098	0.62	0.005	0.09	0.2		6	11.5		6	11.5	PC
1810	00300	OXYGEN, DISSOLVED (MG/L)	110	110	6.135	4.8	5.85	7.307	1.64	13	1.2	1.6	5		25	22.7	0	25	22.7	PC
	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	52	52	2.683	0.518	2.15	5.537	2.225	7.99	0.08	3.405	1	N	35	67.3	0	35	67.3	C
	00625	NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)	21	21	0.78	0.6	0.7	1.101	0.282	1.6	0.27	0.2	1		4	19.0		4	19.0	PC
	00665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	54	54	0.803	0.346	0.565	1.434	0.531	2.14	0.17	0.844	0.2		53	98.1		53	98.1	C
	00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P)	54	54	0.647	0.234	0.48	1.324	0.504	2.13	0.005	0.6	0.2		48	88.9		48	88.9	C
1811	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	58	58	1.625	1.383	1.645	1.8	0.353	2.7	0.224	0.261	1	N	56	96.6	0	56	96.6	C
1812	01049	LEAD, DISSOLVED (UG/L AS PB)	18	5	4.7	0.59	2	10	4.354	10	0.5	9.15	7.2027	N	2	40.0	10	0	0.0	PC
	01075	SILVER, DISSOLVED (UG/L AS AG)	18	1	1	0.42	1	0.58	0	1	1	0.4	0.49	N	1	100.0	2	0	0.0	PC
1813	01025	CADMIUM, DISSOLVED (UG/L AS CD)	14	14	0.714	0.5	0.5	1.205	0.525	2	0.5	0	1.5595	N	2	14.3	1	2	14.3	PC
	01049	LEAD, DISSOLVED (UG/L AS PB)	14	7	4.714	1.46	2.5	11.6	6.278	20	0.5	0	5.331	N	1	14.3	10	1	14.3	PC
	01075	SILVER, DISSOLVED (UG/L AS AG)	14	2	1	1	1	1	0	1	1	-0.05	0.49	N	2	100.0	2	0	0.0	PC
1814	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	23	23	1.221	1.034	1.17	1.335	0.301	2.46	0.78	0.178	1	N	20	87.0	0	20	87.0	C
1816	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	184	184	2.221	0.4	0.9	1.9	14.58	199	0.07	0.882	1	N	73	39.7	0	73	39.7	PC
1817	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	136	136	1.479	0.4	0.82	1.968	2.496	23	0.1	0.9	1	N	57	41.9	0	57	41.9	PC
1818	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	185	185	1.113	0.3	0.5	1	3.424	33	0.03	0.4	1	N	26	14.1	0	26	14.1	PC
12540[1]	00300	OXYGEN, DISSOLVED (MG/L)	48	48	7.142	5.278	6.805	9.335	1.703	10.81	4.74	2.428	6		15	31.3	0	15	31.3	C
12563[2]	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	66	66	4.552	0.733	1.9	12.7	4.837	14.6	0.13	5.6	1	N	47	71.2	0	47	71.2	C
	00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P)	15	15	0.059	0.013	0.023	0.139	0.09	0.294	0.012	0.018	0.2		2	13.3		2	13.3	PC
12564[3]	00300	OXYGEN, DISSOLVED (MG/L)	47	47	7.892	5.648	7.7	9.9	2.095	12.8	3	3.052	6		8	17.0	0	8	17.0	PC
	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	49	49	12.72	6.114	14.2	17.94	5.155	19.7	0.05	7.8	1	Y	48	98.0	0	48	98.0	C
12565[4]	00620	NITRATE NITROGEN, TOTAL (MG/L AS N)	60	60	4.729	1.3	2.2	7.657	7.029	30.7	0.6	2.229	1	N	54	90.0	0	54	90.0	C
12568[5]	00010	TEMPERATURE, WATER (DEGREES CENTIGRADE)	15	15	26.97	16	28.3	34.03	6.923	36	13.5	11.02	33.889		4	26.7		4	26.7	C
	00665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)	11	11	0.201	0.071	0.19	0.354	0.151	0.55	0.01	0.196	0.2		5	45.5		5	45.5	PC
	00671	PHOSPHORUS, DISSOLVED ORTHOPHOSPHORUS(MG/L AS P)	11	11	0.109	0.01	0.15	0.208	0.081	0.22	0.005	0.162	0.2		2	18.2		2	18.2	PC

[1] CARPERS CREEK ON KNOX RANCH 4 MILES SOUTHEAST OF FISCHER
[2] THIRD CREEK, 0.2 KM ABOVE CONFLUENCE WITH GUADALUPE RIVER
[3] THIRD CREEK, 0.5 KM ABOVE CONFLUENCE WITH GUADALUPE RIVER
[4] THIRD CREEK AT SPUR 100 IN KERRVILLE
[5] FIFTEENMILE CREEK AT US 183 SOUTH OF CUERO

As the data and screening procedures in this assessment are nearly identical to that used in the 1994 assessment, this analysis will focus only on the differences. Table D5-1 presents a comparison of the Step 4 results in 1994 and 1996, organized by segment. The results are very similar, with no differences in temperature, pH and DO, and the elimination of PC-C results for FC. These parameters can be dropped from segment discussion as they are all NC (no concern) reports. However, a few individual stations that were not associated with segments will be discussed in relation to these parameters.

One of the stations was 12540, Carper's Creek, a tributary to the Blanco River, segment 1813. This TNRCC station has two brief periods of intensive monitoring, one of which was in September, 1988. During that time many of the DO observations were less than 6 mg/L (the lowest was 4.7 mg/L), resulting in a C on Table D4-3. This does not appear to be a serious concern. The next stations were 12563, 64 and 65, which are on Third Creek in Kerrville and which are dominated by the Kerrville WWTP effluent. In addition to the usual nutrient parameters, 8 out of 47 DO observations were lower than 6 mg/L. The third station was 12568, Fifteen Mile Creek at US 183. In addition to nutrients, this station had 4 of 15 observations above the temperature screening level of 93 °F (33.889 °C), with the highest being 96.8 °F and the mean 80.5 °F. This does not appear to be a thermal pollution concern.

There are some differences with the 1994 assessment in the dissolved solids parameters--TDS, CL and SO4. Part of the difference stems from there being a small amount of additional data and part comes from the Paradox script being hardwired to only employ data beginning in 1990, rather than the 1982 beginning point in the previous assessment. One change is that segment 1803 no longer shows the C that was associated with the San Antonio River values, probably reflecting a somewhat wetter period of record. Similar changes were found for segment 1804 for TDS, 1806 for CL, and 1811 for SO4. Segment 1812 switched from NC to PC for SO4. In this case one year's average exceeded the criterion which, because there was only six years of record, triggered the PC. Some segments changed from NC to ID, probably reflecting the shorter period of record. Segment 1807 (Coleto Creek) changed from C to NC for a different reason; a USGS station which had caused the C result was moved by the TNRCC to a separate station. Overall, the results were as before with no actual water quality concerns associated with dissolved solids for the segments.

As noted in Table D4-2, two stations exceeded the ambient dissolved solids criteria in a convincing manner. One was 12564, which is effluent from the City of Kerrville and should not be compared to ambient criteria, and the other is 13657, Sandies Creek. As noted in the 1994 Assessment,

TABLE D5-1
COMPARISON OF 1994 AND 1996 ASSESSMENT RESULTS

Segment		Conclusion of Water Quality Assessment for																			
		Temp.		pH		TDS		CL		SO4		DO		FC		Nutrients		Metals		Organics	
		1994	1996	1994	1996	1994	1996	1994	1996	1994	1996	1994	1996	1994	1996	1994	1996	1994	1996	1994	1996
1701	Victoria Barge Canal	NC	NC	NC	NC	NA	NA	NA	NA	NA	NA	NC	NC	C	NC	PC	PC	ID	NC	ID	ID
1801	Guadalupe River Tidal	NC	NC	NC	NC	NA	NA	NA	NA	NA	NA	NC	NC	PC	NC	C	C	C	PC	ID	ID
1803	Guadalupe River Below San Marcos River	NC	NC	NC	NC	C	NC	C	NC	NC	NC	NC	NC	C	NC	C	C	C	C	ID	PC
1804	Guadalupe River Below Comal River	NC	NC	NC	NC	PC	NC	NC	NC	NC	NC	NC	NC	NC	NC	C	PC	ID	PC	ID	ID
1805	Canyon Lake	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	ID	ID	ID	ID
1806	Guadalupe River Above Canyon Lake	NC	NC	NC	NC	NC	NC	PC	NC	NC	NC	NC	NC	NC	NC	PC	PC	NC	PC	ID	ID
1807	Coleto Creek	NC	NC	NC	NC	C	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	ID	ID	ID	ID
1808	Lower San Marcos River	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	C	C	ID	ID	ID	ID
1809	Lower Blanco River	NC	NC	NC	NC	NC	ID	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	ID	ID	ID
1810	Plum Creek	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	PC	PC	NC	NC	C	C	ID	ID	ID	ID
1811	Comal River	NC	NC	NC	NC	NC	NC	NC	NC	PC	NC	NC	NC	NC	NC	C	C	ID	ID	ID	ID
1812	Guadalupe River Below Canyon Dam	NC	NC	NC	NC	NC	NC	NC	NC	NC	PC	NC	NC	NC	NC	NC	NC	ID	PC	ID	ID
1813	Upper Blanco River	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	PC	PC	ID	ID
1814	Upper San Marcos River	NC	NC	NC	NC	ID	NC	ID	ID	NC	NC	NC	NC	NC	NC	C	C	ID	ID	ID	ID
1815	Cypress Creek	NC	NC	NC	NC	NC	NC	NC	ID	NC	ID	NC	NC	NC	NC	NC	NC	ID	ID	ID	ID
1816	Johnson Creek	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	PC	PC	ID	ID	ID	ID
1817	North Fork Guadalupe River	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	PC	PC	ID	ID	ID	ID
1818	South Fork Guadalupe River	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	PC	PC	ID	ID	ID	ID

Note:
ID = Insufficient data. PC = Possible concern. NA = Marine waters, criteria do not apply.
NC = No detectable concern. C = Concern.

the Sandies Creek station is in a different watershed from the main stem of the river, where the comparison criteria were drawn. Neither station result indicates an actual water quality concern.

The next parameter to be addressed is nutrients. Here the two assessments are nearly identical. The only difference is that segment 1804 switched from a C to a PC. This appears to be because of the small addition of data points (increase from 152 to 166) caused the percent exceeding the 1 mg/L screening level to drop from 51.3% to 49.4%. Clearly this difference is not significant. The basic conclusion of the 1994 Assessment, that nutrient C-PC results are a function of the screening criteria selected, still holds.

The metals results show a substantial number of differences between the two assessments. Some of the reasons for the differences are: the addition of new data, the use of somewhat different hardness values in the calculation of the freshwater criteria, and the method of determining whether the Insufficient Data tag should be applied. However, these differences are relatively minor in comparison to the basic point discussed in the 1994 Assessment that the data were obtained with methods that are not considered reliable for quantification at the levels employed for screening. Referring back to Table D4-3 which includes the details of the metal screenings, it can be seen that the dissolved values are quite low, with a small percentage exceeding the screening levels (which is still sufficient to produce a PC). The only C result came from older total lead data (4 samples). The differences with the '94 Assessment involving IDs are a result of different interpretations of the Guidance on how a screening exceedance, even if there are not enough samples to meet the criteria, should be counted. Overall, the metals results are the same as in the 1994 Assessment, with no indication of a water quality problem.

The final parameter is the organics. As in the 1994 Assessment, there is very little organic data. This is to be expected as there are very few potential sources of industrial organic compounds and thus little need for extensive monitoring of these substances. The database does include a substantial amount of pesticide data collected over the years. These data did not exceed screening levels. The only organic value to trigger a PC was one sample out of 11 measurements of PCBs in water in segment 1803. The basic conclusion is the same as in 1994--there is not a water quality concern with organic chemicals in the basin.